# Delaware River Basin Commission

# **Draft Water Resources Program**

## FY 2018-2020

**January 2018**

## Authorization

The Delaware River Basin (DRB) Compact states:

> *The commission shall annually adopt a water resources program, based upon the comprehensive plan, consisting of the projects and facilities which the commission proposes to be undertaken by the commission and other authorized governmental and private agencies, organizations and persons during the ensuing six years or such other reasonably foreseeable period as the commission may determine.* (§ 3.2 DRB Compact, 1961)

According to the Compact, *"Project" shall mean any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation* (§1.2.(g)).

## Scope and Organization

The Water Resources Program (WRP) covers fiscal years (FY) 2018 through 2020 (July 1, 2017 through June 30, 2020) and is an element of strategic planning for DRBC program direction over the next three years. The architecture is based on the requirements of the Delaware River Basin Compact (Compact) and the goals of the Key Result Areas of the *Water Resources Plan for the Delaware River Basin* (Basin Plan 2004).

The Program is presented in two parts:

**Section I: Conditions** summarizes water resource conditions in the Basin, including hydrologic conditions, water use and sufficiency, overall assessment of water quality, landscape conditions, and emerging issues that could affect long-range water resource planning and management in the Basin.

**Section II: Work Program** notes the key issues that focus the Commission's programs and summarizes by Key Result Area the initiatives the Commission plans to undertake over the next three years.

# DRBC Water Resources Program FY 2018 - 2020

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## FY 2018-2020

## I. General Statement of Conditions in the Basin

### A. Hydrologic Conditions 2016-2017

**Rainfall**.
Compared to the rest of the continental US, the northeastern region of the country experienced above-average precipitation during the 365-day period ending June 2017.[1] In comparison, the Delaware River Basin (DRB) precipitation averaged 2.23" below normal (4.6 percent) for the same period. [2]

Note: Annual reports on basin hydrologic conditions are available at: http://www.nj.gov/drbc/hydrological/reports/annual-hydro-reports.html

**Reservoir Conditions and Management.**
Combined storage in the three New York City (NYC) reservoirs, located in the DRB, was slightly below the long-term median on July 1, 2016 (Figure 1) and remained at or below the median during the summer months. On November 23, 2016, combined storage in the three NYC reservoirs decreased below the drought watch operations rule curve, prompting DRBC to issue Resolution No. 2016-7 for a basinwide drought watch. Storage continued to decrease and reached a minimum of 106.4 billion gallons (39.3% of usable capacity) on November 28. Precipitation during late November and into December raised the combined NYC reservoir storage above the drought watch threshold before the end of 2016, but the criteria for ending the drought watch were not met until later in January. On January 18, 2017. the combined storage in the three NYC reservoirs was more than 15 billion gallons (BG) above the drought watch threshold for five consecutive days, automatically terminating the basinwide drought watch. Storage continued to increase and the reservoir system refilled to usable capacity of 271 BG in early April. Storage remained above the median at the end of June 2017.

The USGS River Master directed releases from the three NYC reservoirs from June through November 2016 to meet the flow objective at Montague, New Jersey. Under normal conditions, the flow objective is of 1,750 cubic feet per second (cfs). During the basinwide drought watch period (November 23, 2016 – January 18, 2017), the flow objective was re1,650 cfs. Approximately 66.7 BG was released from the NYC reservoirs during this period.

In the Lower Basin, DRBC released close to nine billion gallons of water from Beltzville and Blue Marsh reservoirs from September through November 2016 to meet the Trenton Flow Objective. Under normal conditions, the flow objective at Trenton is 3,000 cfs, and 2,700 cfs during basinwide drought watch. The intent of the flow objective is to slow the upstream movement of salt water into the Delaware Estuary. Although below-normal precipitation and frequent releases reduced storage in the two reservoirs, the criteria for a lower basin drought were not met. Beltzville and Blue Marsh storages rebounded early in 2017.



[1] NOAA. State of the Climate National Overview-Regional 12 Months Precipitation June 2017. http://www.ncdc.noaa.gov/temp-and-precip/us-maps/12/201606?products[]=regionalpcpnrank#us-maps-select
[2] NWS Middle Atlantic River Forecast Center-monthly precipitation data reported by 38 of the 42 DRB counties. DRBC staff calculated cumulative 12-month precipitation departure from normal.

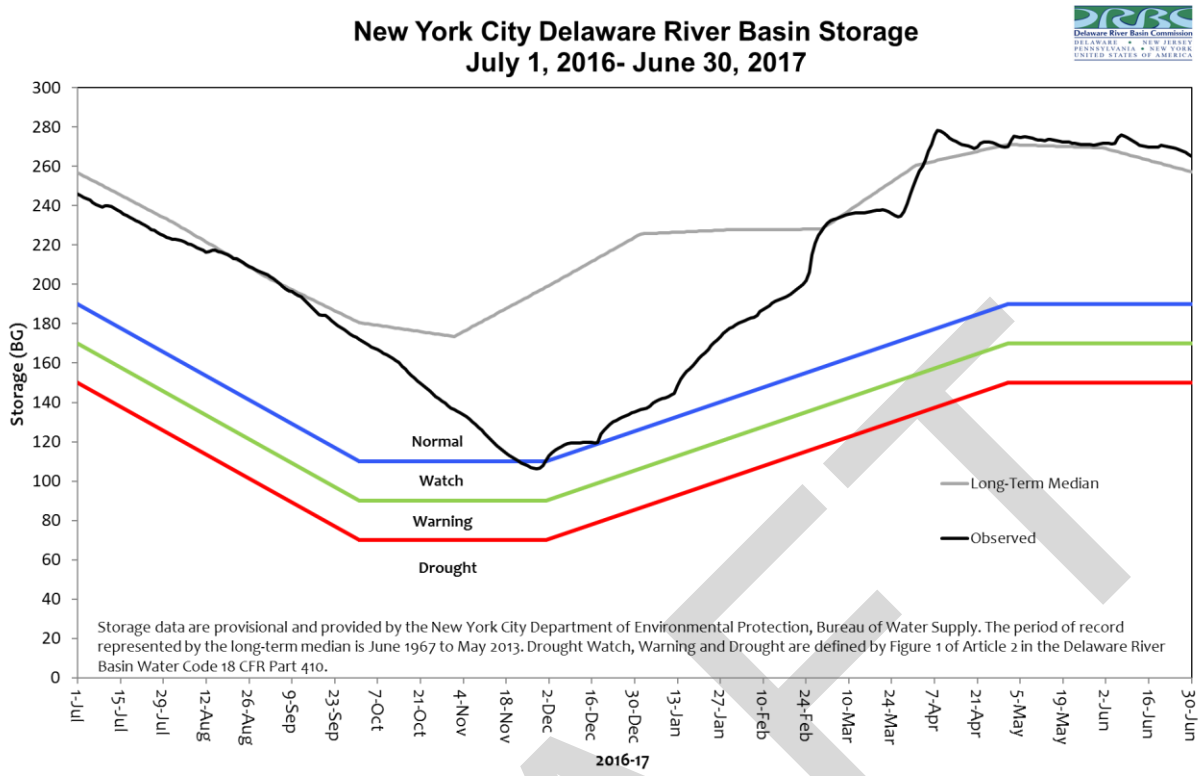



**Figure 1. New York City's Delaware River Basin Storage, July 2016-June 2017.**

**Groundwater Conditions.**

**New York**

The groundwater level in the Sullivan County observation well (Figure 2) remained below the long-term median during July through December 2016. The water level was at its lowest value in late November. The well recharged with improved precipitation in 2017 and the water level was above the long-term median on June 30, 2017.

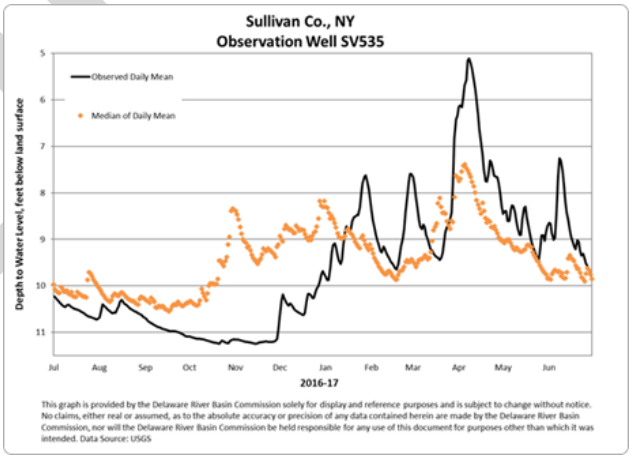
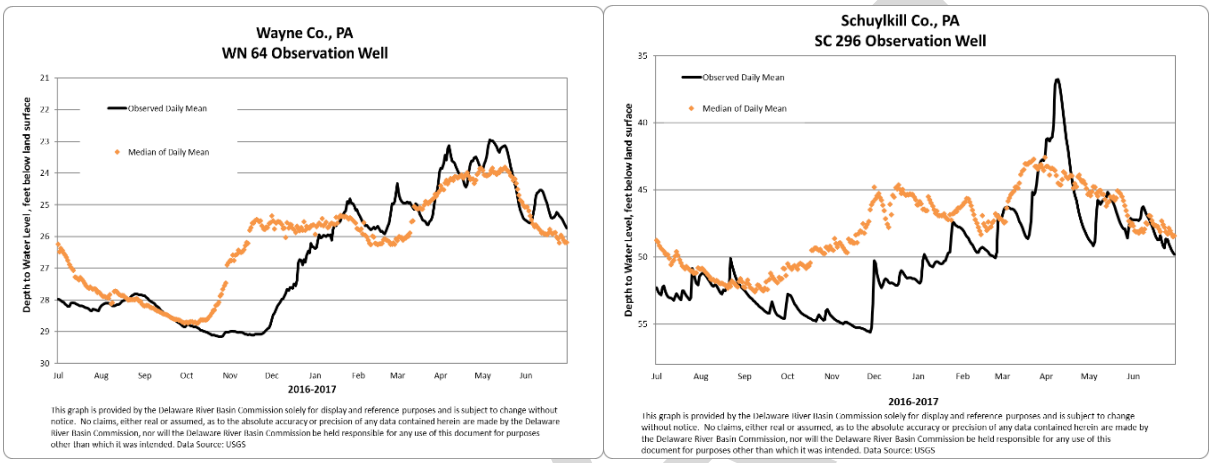



**Figure 2. USGS Well in Sullivan Co., NY. July 2016-June 2017 Observed Daily Mean (black line) vs. Median of Daily Mean (orange line) measurements.**

**Pennsylvania**

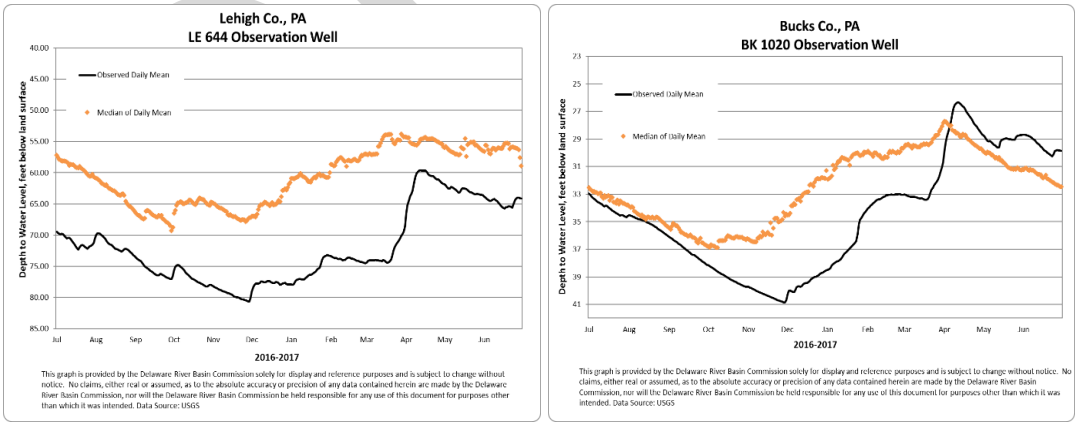
Groundwater levels in five selected USGS county observation wells were used to represent Pennsylvania's groundwater conditions during July 2016 - June 2017. The individual wells were selected based on their geographic locations in the Pennsylvania portion of the DRB: Wayne County WN 64 (northern), Schuylkill County SC 296 (western), Lehigh County LE 644 (central), Bucks County BK 1020 (eastern), and Chester County CH 10 (southern).

In the upper basin, water levels in the Wayne County and Schuylkill County observation wells (Figures 3 and 4) were below the median at the start of the report period, decreasing as dry conditions persisted. Water levels in both wells recovered during 2017.




**Figures 3 and 4. USGS wells in Wayne Co., PA and Schuylkill Co., PA. July 2016-June 2017 Observed Daily Mean (black line) vs. Historical Median of Daily Mean (orange line) measurements.**

Water levels in both the Lehigh County and Bucks County observation wells (Figures 5 and 6) were below the historical median in July of 2016. The water level in the Lehigh County well began to improve in December, but remained several feet below the median level in June 2017. The Bucks County well also began to recover in December 2016 and was above the median by Spring 2017.




**Figures 5 and 6. USGS wells in Lehigh Co., PA and Bucks Co., PA. July 2016-June 2017 Observed Daily Mean (black line) vs. Historical Median of Daily Mean (orange line) measurements.**

Levels in the Chester County well (Figure 7) started and ended the report period below the historical median. The water level was at its lowest during the peak of the drought in late November 2016 and showed a marked improvement during spring 2017.

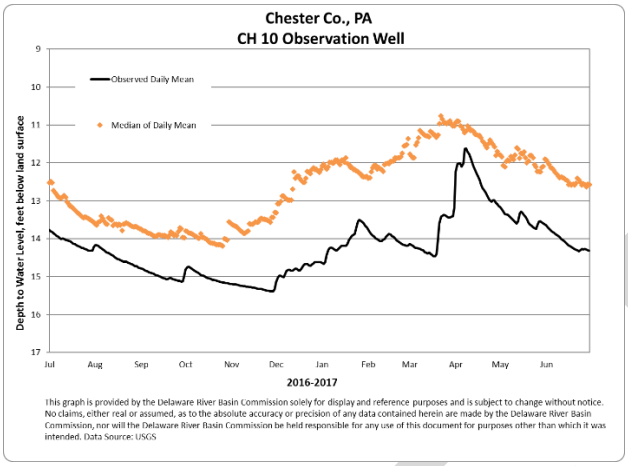



**Figure 7. USGS well in Chester Co., PA. July 2016-June 2017 Observed Daily Mean (black line) vs. Historical Median of Daily Mean (orange line) measurements.**

## New Jersey

The well in Cumberland County (Figure 8) in the coastal plain declined below the historical median during the peak of the drought in November and remained below the median for the remainder of the report period.

## Delaware

The well in New Castle County (Figure 9) remained below the median for the entire report period. The water level recovered slightly during spring and early summer 2017.

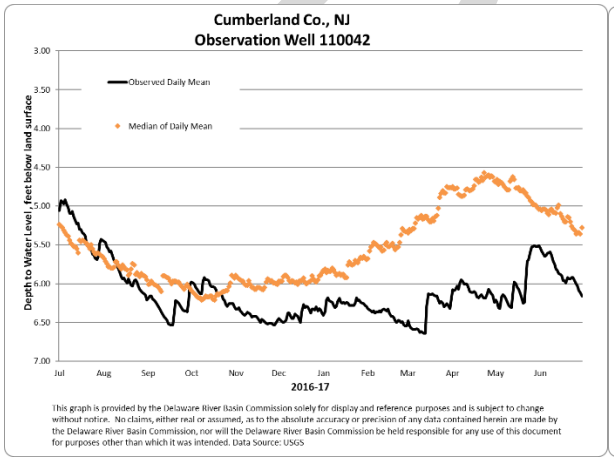



**Figure 8. USGS well in Cumberland Co., NJ. July 2016-June 2017 Observed Daily Mean (black line) vs. Historical Median of Daily Mean (orange line) measurements.**

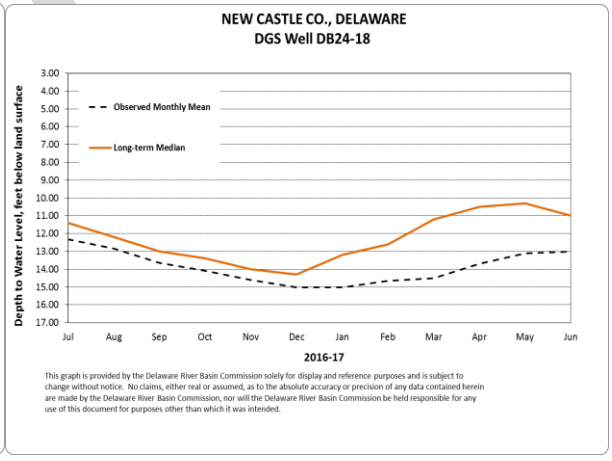



**Figure 9. DGS well in New Castle Co., DE. July 2016-June 2017 Observed Monthly Mean (dashed black line) vs. Historical Monthly Median (orange line) measurements.**

## B. Water Use and Sufficiency

### Water Withdrawals and Trends

Understanding water withdrawals, water use, and supply is integral to the management of water resources. In recent years, our understanding of the ways in which water is withdrawn and used has improved greatly, as have the underlying systems in place to manage the data, meaning that more timely and comprehensive assessments can be made. Figure 10 shows the basin-wide picture of water withdrawals, exports, and consumptive use, by sector, based primarily on 2014 calendar year water use data; the data shown represent daily average withdrawals.

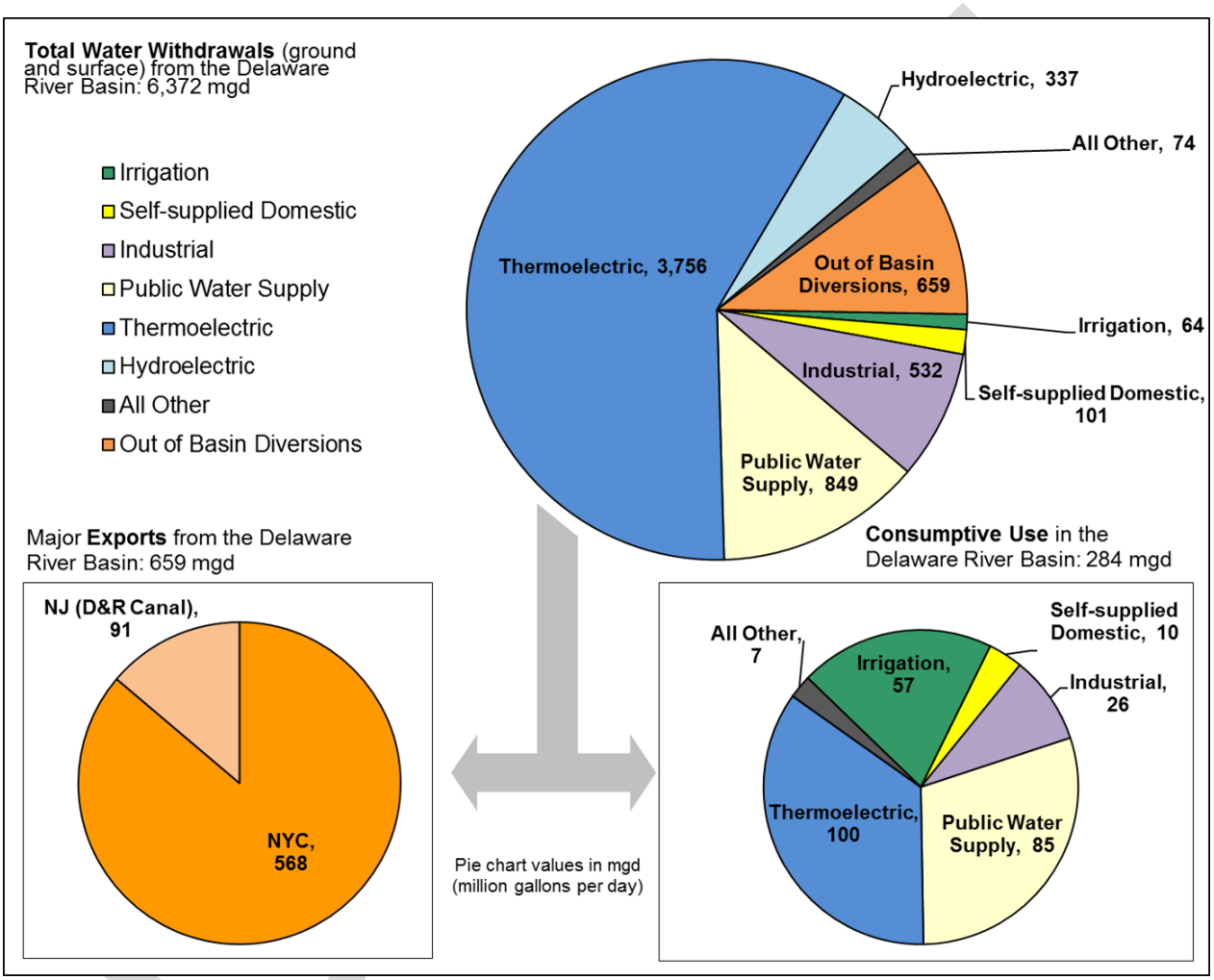



**Figure 10. Withdrawals, Consumptive Use and Major Exports from the Basin 2014. (Note: for Self-supplied domestic estimates from other reporting years have been used as more recent data were not readily available.)**

Key Delaware River Basin water use facts:

- Roughly 15 million people rely on water from the Basin for their daily water needs. Approximately 8.3 million people live in the Basin (2010 US Census), and the volume of exports to New York City and northeastern New Jersey is sufficient to supply water to an additional 7 million people;
- Total ground and surface water withdrawals from the Basin: 6,372 mgd (6.3 Billion gallons per day);
- Major Exports from the Basin: 659 mgd;

- Consumptive Use in the Basin: 284 mgd;
- Over 90% of all water used in the Basin is obtained from surface waters; and
- Three dominant use sectors account for approximately 80% of total water withdrawals; these sectors are: power generation ("Thermo," 59%), public water supply ("PWS," 13%), and industrial use ("Industrial," 8%).

DRBC tracks withdrawals and water use in these three dominant water using sectors closely. Currently, data for these key sectors extend through calendar year 2014 and provide a monthly time series of data spanning a period of over 20 years. Although Figures 11 and 12 contain some data gaps, an overall pattern and trend in water withdrawals and consumptive use is apparent. The public water supply and industrial sectors display decreasing trends in total water withdrawn as well as water consumptively used. Public water supply downward trends are primarily attributed to the influence of conservation practices, while industrial use downward trends are more likely the result of facilities exiting the industrial sector through closure or relocation outside the Basin. The thermoelectric sector displays an overall decreasing trend in total water withdrawals, but increases in consumptive use. This is attributed to the increasing use of cooling towers as opposed to once through cooling for new or upgraded facilities.

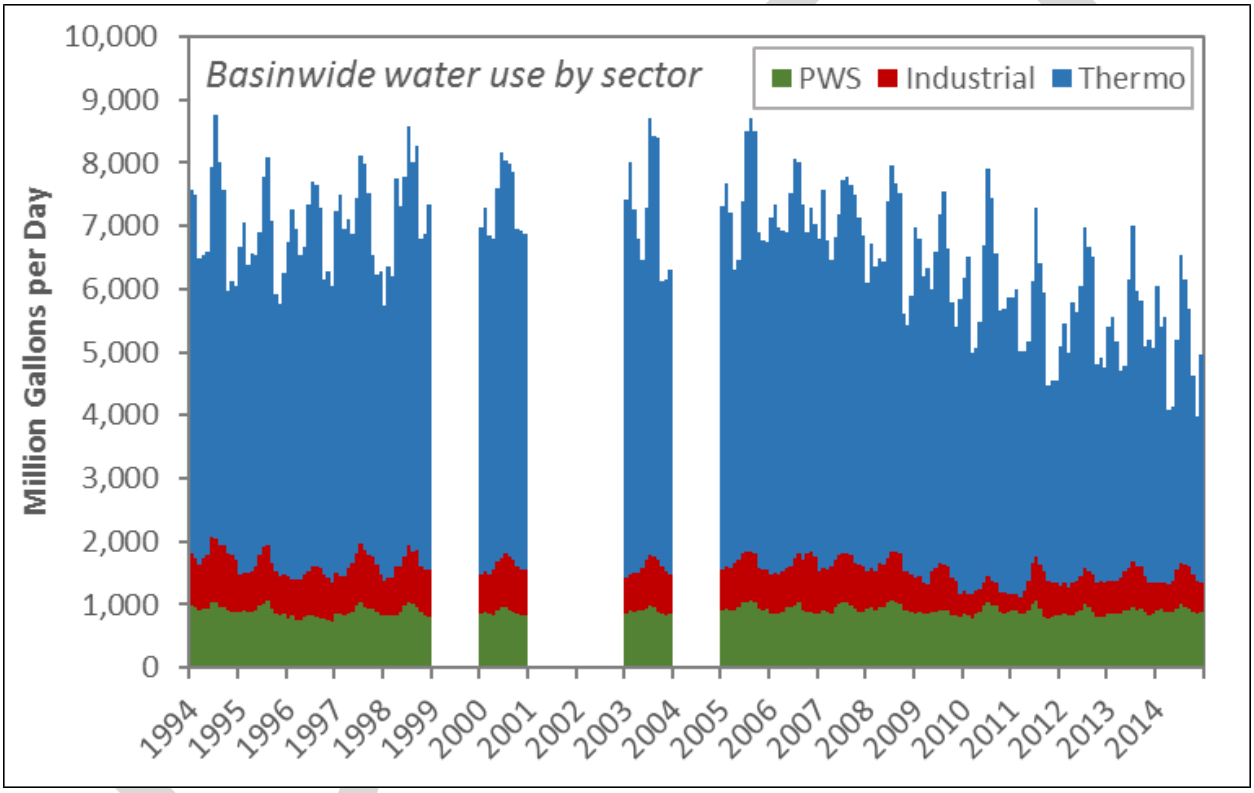



**Figure 11. Monthly Water Withdrawals for Three Key Sectors in the Delaware River Basin. (Note that no data are shown for months where data were incomplete to avoid visually skewing the trends).**

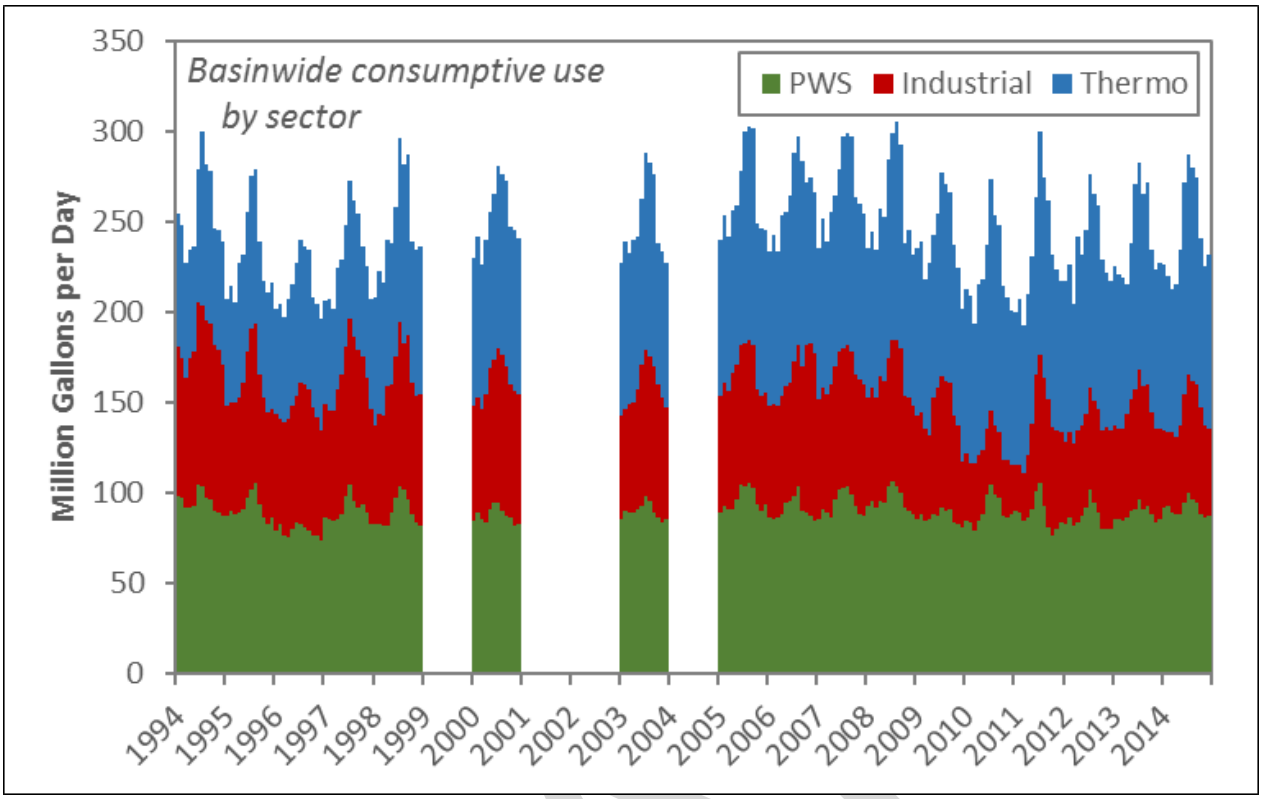



**Figure 12. Monthly Consumptive Water Use for Three Key Sectors in the Delaware River Basin. (Note that no data are shown for months where data were incomplete to avoid visually skewing the trends).**

### Water Withdrawals and Consumptive Use

In managing water resources, the withdrawal volume may not be as important as where, when, and if water is returned to the system. Water not returned to the surface waters of the basin is considered consumptive use. Figure 13 illustrates both the range of withdrawals among the basin regions (see basin map in Figure 14) and consumptive use as a percentage of total withdrawals (excluding exports to NYC and NJ).

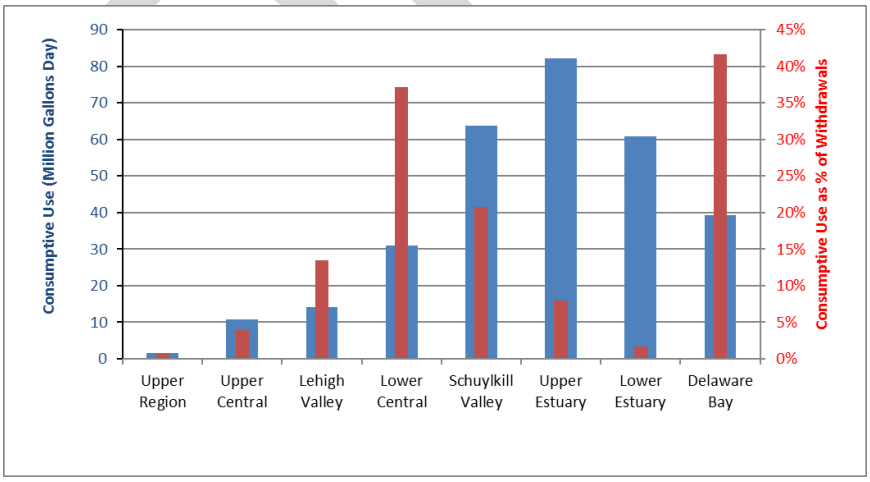



**Figure 13. Consumptive Use 2014 by Basin Region as total withdrawal (wide blue bar, see left axis) and as percentage of withdrawals (narrow red bar, see right axis).**

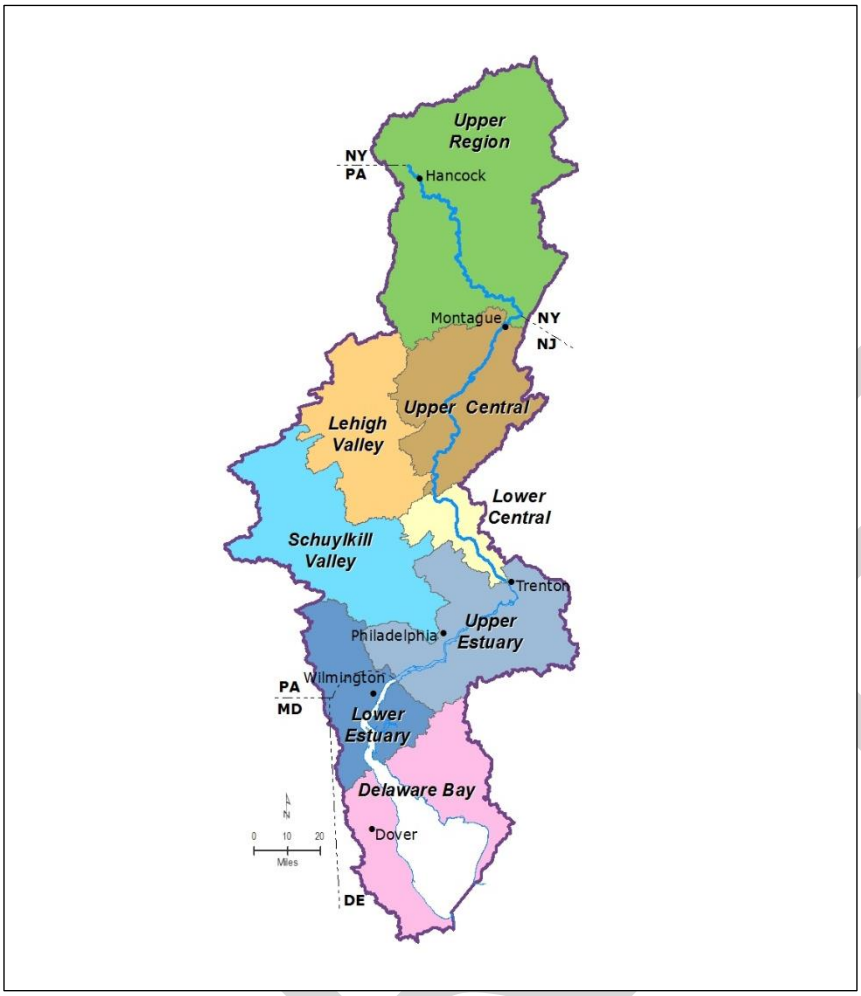



**Figure 14. Map of Basin Regions**

**Cumulative Thermoelectric Withdrawals and Consumptive Use**

Water withdrawals for thermoelectric power generation are primarily used for cooling purposes. The cooling process is typically achieved by either highly evaporative cooling towers or a once-through cooling process that uses a condenser to absorb heat. The two types of cooling use water in different ways. Evaporative cooling towers require a smaller volume of withdrawal but consume most of the water (typically >90% consumptive use). Once-through cooling requires much greater volumes of water at the intake, but the rate of loss to evaporation is very small (typically <1%). In terms of total consumptive use per energy unit (gallons per MWh), cooling towers have higher consumptive use factors. On average, cooling towers use 453 gal/MWh, while once-through systems use 307 gal/MWh. A decline in withdrawals for thermoelectric power generation over the past several years is evident in Figure 6 and is a result of plant closings, or decreased production, at facilities with once-through cooling systems.

However, the need for energy production in the basin continues to increase and other (smaller) facilities have come online to meet demand. The new facilities use evaporative cooling, which withdraws a lesser volume but evaporates a greater percentage of the withdrawal. Figure 15 shows the resulting increasing trend in consumptive water use, despite a decrease in overall water withdrawn for the thermoelectric power generating sector.

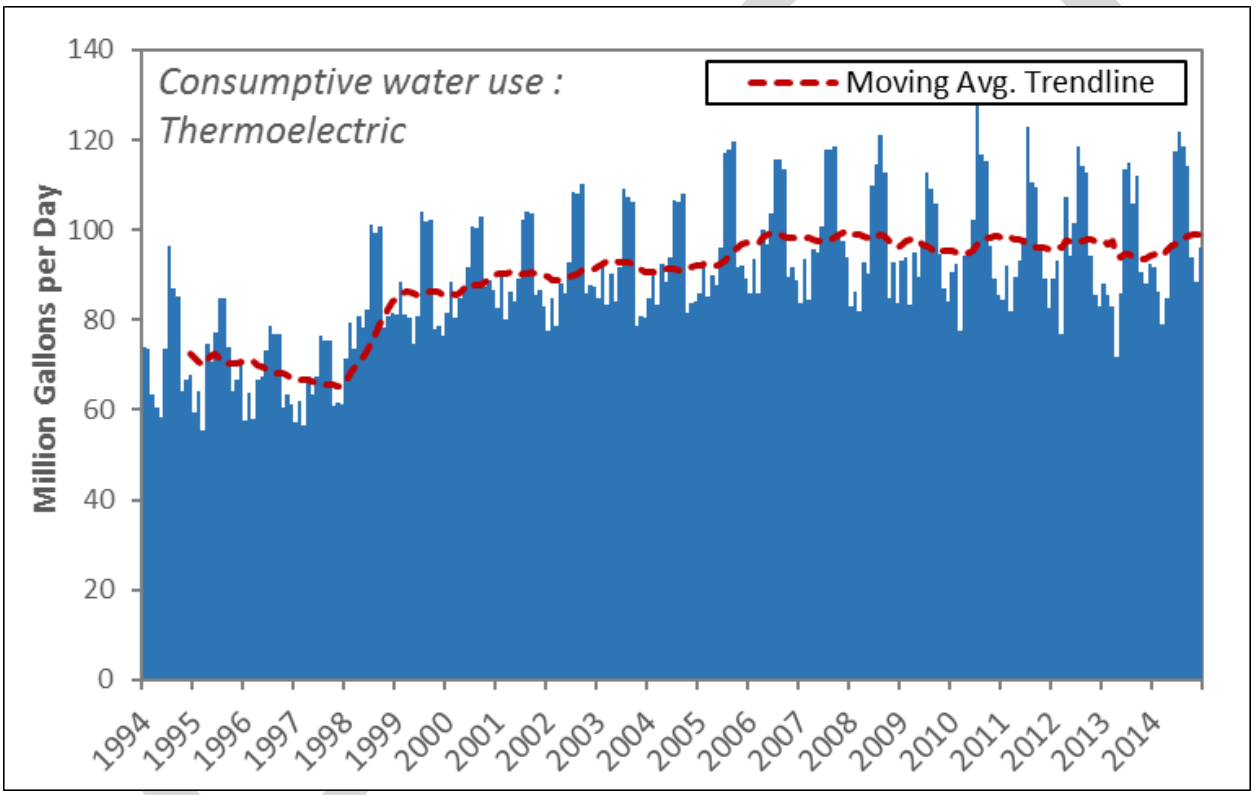



**Figure 15. Trend in Consumptive Use for Thermoelectric Power Generation in 1994-2014. Trendline is calculated as a 12-month moving average.**

Increases in demand for withdrawals for thermoelectric power generation are likely to occur in the future. Any new capacity is likely to be cooled using evaporative methods (e.g., cooling towers) as required under USEPA regulations, potentially increasing consumptive water use.

**Public Water Supply Withdrawals**

Historic data for public water supply (PWS) withdrawals show a slight declining trend (see Figure 16) largely driven by water conservation measures in the form of changes in plumbing codes, enacted in the early 1990s, which require use of more efficient plumbing fixtures and fittings. In addition, education and awareness of water conservation practices have played a role in decreasing water use for this sector despite increases in population (shown by the red line in Figure 16). Although declining in the aggregate, withdrawals have increased in several systems where there are population growth regions (i.e., where water conservation practices cannot offset the more rapid increase in population). Over the past 30 years, DRBC has been a leader in enacting regulations to promote water conservation in the areas of source and service metering, leak detection and repair, plumbing fixtures and fittings, and water rate structures. The trend shown in Figure 16 indicates that these regulations have been successful and have contributed to a modest decline in PWS water withdrawals. Figure 16 also shows the consumptive use portion (light green) of the total withdrawals; the non-consumptive portion (dark green) reflects those volumes returned to the basin after withdrawal. (Note that DRBC does not receive or calculate consumptive use data for the public water sector, but rather uses a basinwide "consumptive use factor" of 10 % for public water supply systems).

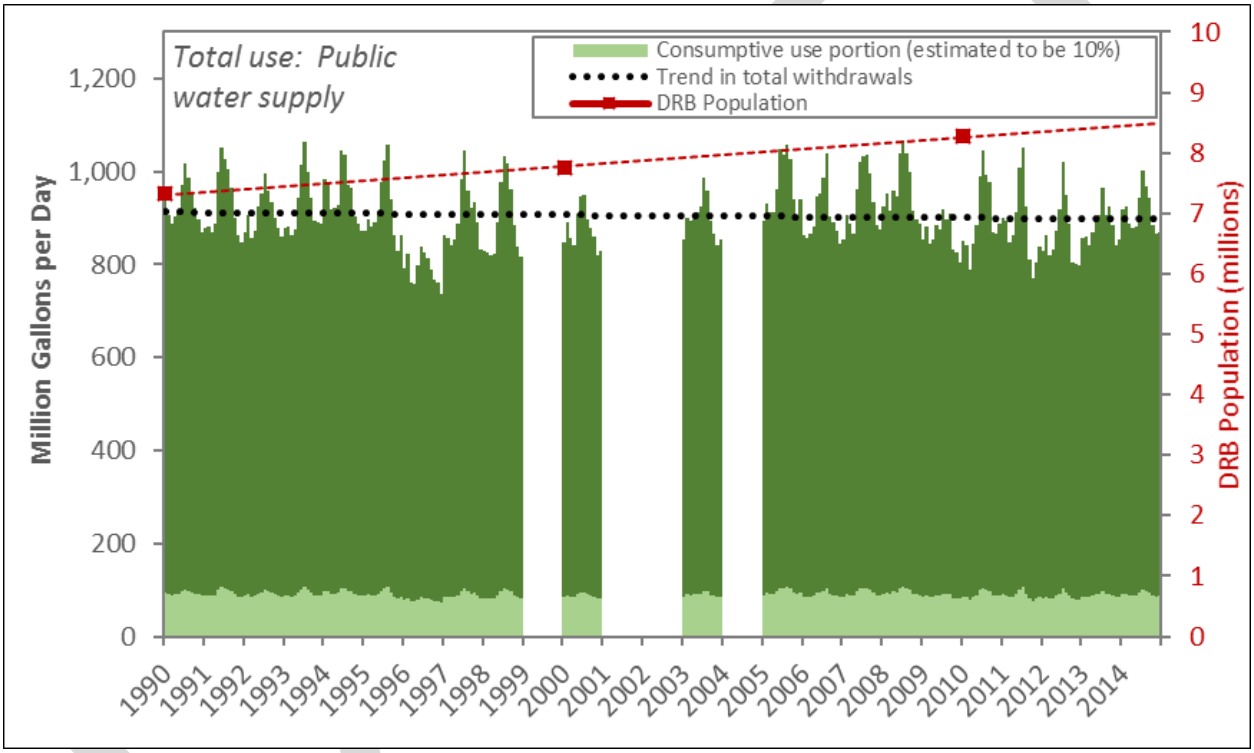



**Figure 16. Monthly withdrawals of Public Water Systems in the Basin 1990-2014. (Note that no data are shown for months where data were incomplete to avoid skewing the displayed trend line).**

In 2009, as part of DRBC's effort to ensure its regulations reflect the latest thinking in the field of water efficiency, the commission amended its Comprehensive Plan and Water Code to implement an updated water audit approach to identify and manage water loss in the basin, in partnership with basin water purveyors. The approach is consistent with the International Water Association (IWA) and American Water Works Association (AWWA) Water Audit Methodology and is considered a best management practice in water loss control. The revised regulations require PWS systems to conduct an annual water audit to help identify water losses, particularly water lost due to leaky infrastructure. DRBC performed multiple outreach efforts and the audit became a mandatory requirement in 2012. Nearly three hundred water audits were available for analysis for the CY2014 Report. Note: This dataset (276 water audits) includes 18 audits submitted in prior calendar years (i.e., 2012 and 2013), but not yet submitted for CY2014 in order to provide a more complete basinwide water use/loss assessment for 2014. Collectively, the audit data indicates that

approximately 730 million gallons per day (MGD) of water was put into distribution systems in the Delaware River Basin. *Non-revenue water* is a key term used in the AWWA water audit methodology to quantify water losses and unbilled water consumption. Non-revenue water is water that has been treated and pressurized and enters the distribution system, but generates no revenue for the water purveyor. Water losses can be real losses (through leaks, also referred to as physical losses) or apparent losses (for example, through theft or metering inaccuracies). Based on the CY2014 reported data, an estimated 140 MGD was reported as physically lost from distribution systems in the DRB along with an estimated 31 MGD reported as apparent losses and 14 MGD of unbilled authorized consumption for a total of 185 MGD of non-revenue water reported in CY2014. This non-revenue water has an estimated annual value of $132 million to water utilities in the DRB and represents a significant opportunity to improve the efficiency of public water supply in the basin. Figure 17 shows a summary of the 2014 results of data collection under the DRBC water audit program.

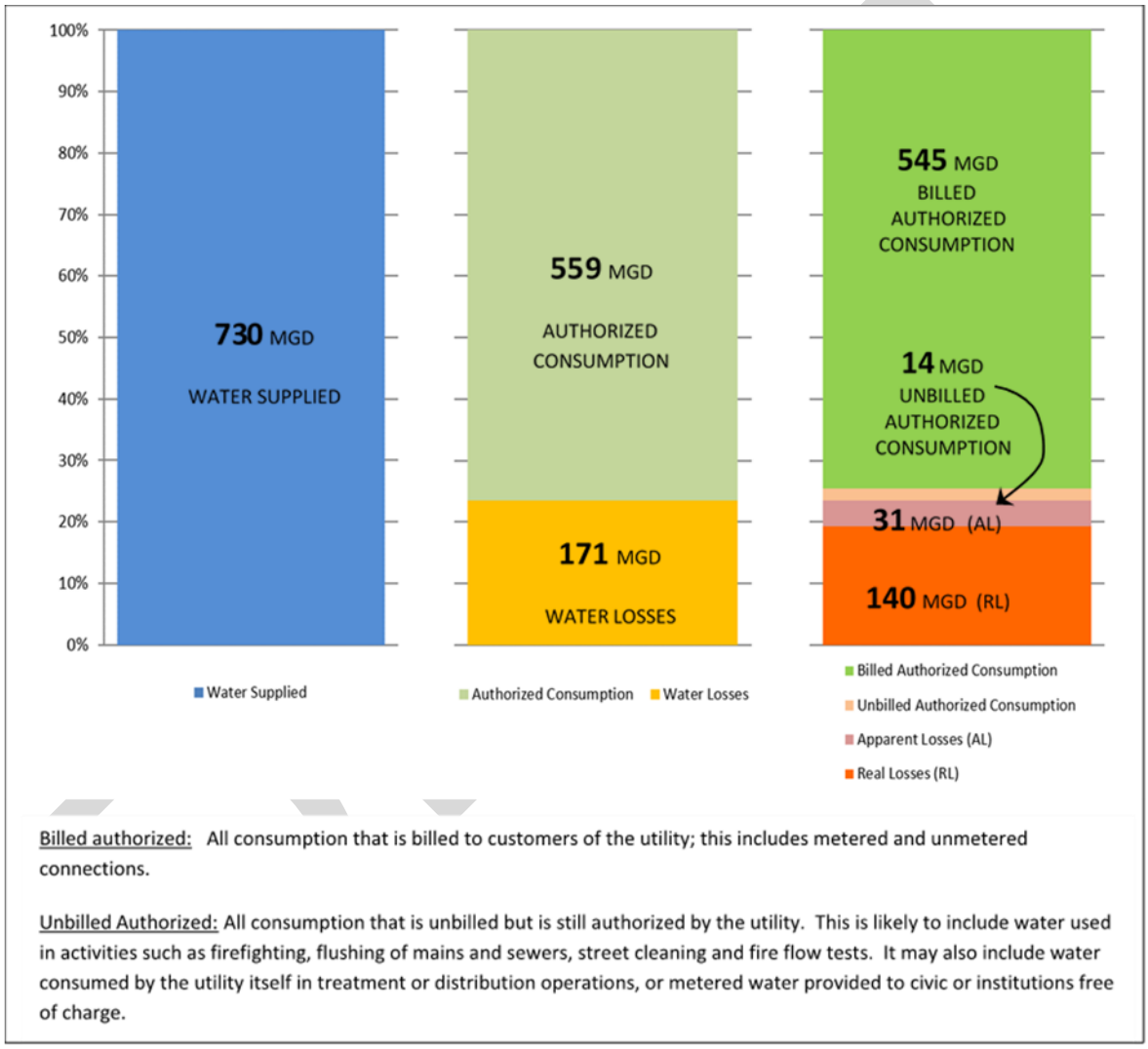



**Figure 17. DRBC water audit program summary (CY2014); aggregate of 276 individual water system audits.**

Data collection under the DRBC's water audit program mark a significant step in a long-term effort to improve water efficiency and promote best practices in water loss control for basin water purveyors. During the first few years of the program, the emphasis will be on ensuring that water purveyors build confidence in the data submitted in the water audit. Developing and providing accurate data to the water audit process will result in a clearer understanding of the causes of water loss and is a vital first step in the process. Furthermore, the water audit emphasizes the importance of calibrating source meters to ensure accurate

measurement of water withdrawn. This also helps improve the accuracy of reported withdrawals of water to state agencies and DRBC for use in other water use studies and assessments. It is anticipated that a focus on this issue will result in an improved efficiency of public water supply systems, saving both water resources and money.

**Industrial Withdrawals**

Historic data for industrial withdrawals show a decline from levels in the early 1990's (Figure 18). The closing of the Bethlehem Steel plant in Bethlehem PA in 1995 contributed significantly to the overall decline in water use for this sector as it was the Basin's largest industrial water user. Over the past decade, industrial water use has declined slightly despite numerous facilities changing hands. Several large refineries in the Basin have seen a lot of turnover in recent years. Refineries that were idle are once again in production and have returned to more normal operations with water withdrawal data returning to previous levels.

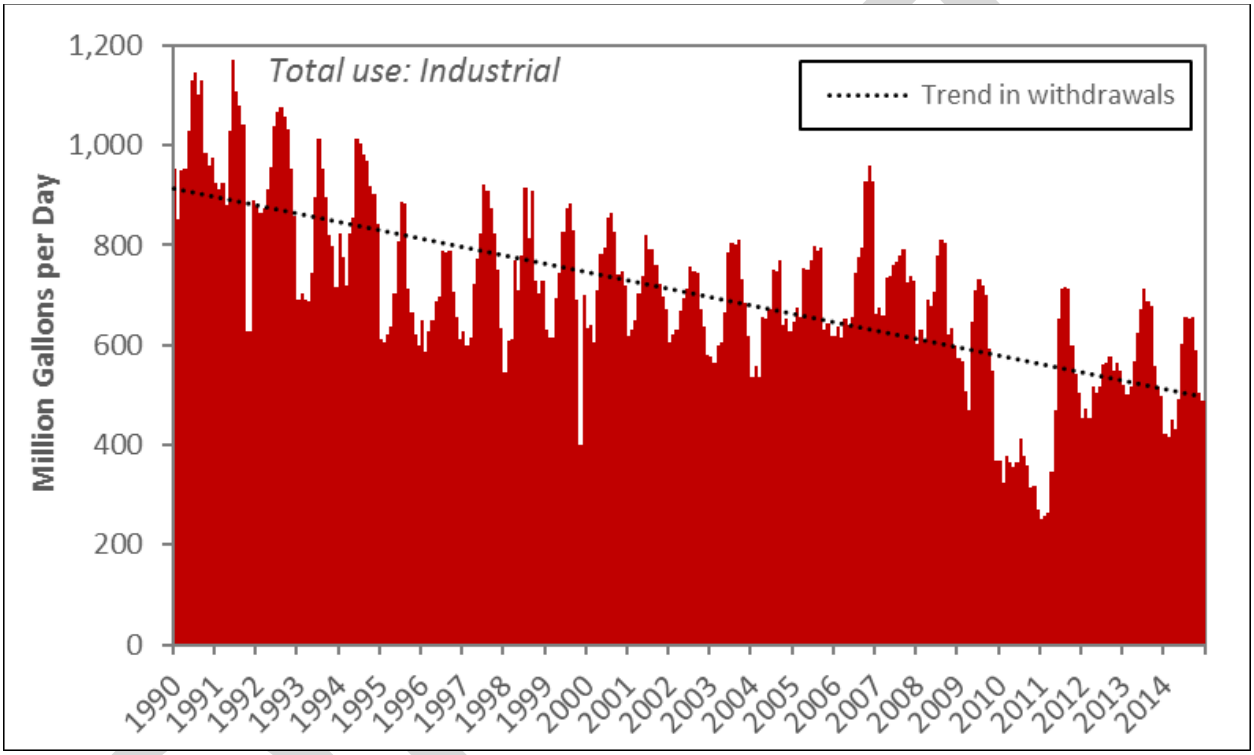



**Figure 18. Monthly Industrial Water Withdrawals 1990 - 2014**

**Seasonal Variation in Withdrawals and Consumptive Use**

The monthly data shown in Figures 11, 12, 15, 16, and 18, highlight the extent to which water withdrawals and consumptive uses vary seasonally. Thermoelectric power generation experiences peaks in the summer months as a consequence of increased power demand for residential and commercial cooling. Simultaneously, public water suppliers experience peak demands in the summer months when lawn-watering and other outside uses are greatest. This highlights the need for including accurate seasonal (peak) considerations—including ecological (instream) needs—in long-range supply sufficiency assessments.

**Ecological (Instream) Flow Needs**

Water supply planning in the basin generally has not taken into account the instream flow needs of aquatic communities principally due to a scarcity of specific quantitative information, especially regarding the relationship of flow to ecological needs. Understanding the instream flows necessary to protect key ecological communities for the range of habitats in the Delaware River Basin is vital for the Commission to effectively manage and plan to meet future water needs for all uses. In April 2012, the Commission and The Nature Conservancy (TNC) began a year-long study to develop basin-wide ecosystem flow recommendations that can be implemented within the subwatersheds of the Delaware River. The study was completed in December 2013. The Commission is currently reviewing options to implement the TNC recommendations. The USGS WaterSMART study also includes an ecological flows component.

**Conditions in Special Groundwater Management Areas**

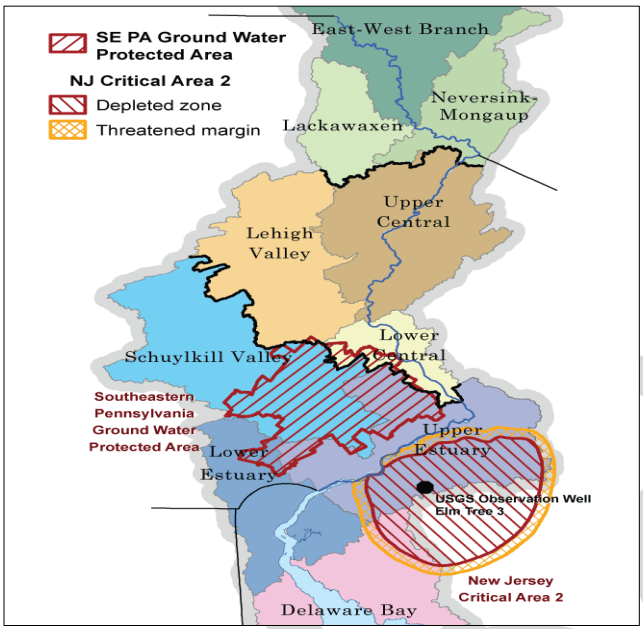



**Figure 19. Groundwater Management Areas in the Delaware River Basin.**

Two areas of the Basin are included in special management programs to mitigate historical groundwater supply issues and prevent future stress. The Commission manages the Southeast Pennsylvania Groundwater Protected Area (SEPA GWPA) on behalf of the Commonwealth of Pennsylvania and New Jersey manages Critical Area 2 in the Potomac-Raritan-Magothy (PRM) aquifer system in southwestern New Jersey (Figure 19).

**Southeast Pennsylvania Groundwater Protected Area.** The SEPA GWPA is an area of 1200 sq. mi. that includes 76 subbasins closely managed by DRBC with regard to groundwater withdrawals, well interferences, and municipal water supply planning. Withdrawal limits have been established for each of the subbasins. Based on an analysis by DRBC using groundwater withdrawal data provided by the PADEP:

Presently, cumulative allocations in some SEPA GWPA subbasins exceed the recommended sub-basin withdrawal limit (Figure 20). In order to plan for future development and an increased demand on groundwater resources, subbasin stress determinations will be made based on docket and SEPA GWPA permit allocations. The Commission will continue to update subbasin usage with current PADEP water withdrawal data and continue to lower cumulative docket/permit allocations to below their respective subbasin withdrawal limits.

- Use in three (3) subbasins is currently between the fifty percent (50%) and seventy-five (75%), of their withdrawal limit.
- Two (2) subbasins are above their withdrawal limits. One subbasin (29) has historically been above its withdrawal limit because a major withdrawal from a quarry reservoir is counted as a groundwater withdrawal by PADEP. The second subbasin (4) has historically vacillated between non-stressed, potentially stressed and above the withdrawal limit. Most of the change in water use is attributable to the Eureka Stone Quarry.
- For any new withdrawal in a “potentially stressed” subbasin, SEPA GWPA regulations provide alternative programs geared toward increasing the groundwater recharge to the underlying formation or that conserve overall groundwater use.

Over the past 16 years, cumulative groundwater use in the SEPA GWPA has decreased (Figure 21). This is likely to be partially attributable to improved water conservation, as noted above and also due to

infrastructure changes, notably the Point Pleasant, PA diversion of surface water from the Delaware River to offset groundwater use by communities in Bucks and Montgomery counties. Figure 16 shows groundwater withdrawal data provided by the PADEP covering the years 1987 through 2015. The groundwater withdrawal data reported in the graph are from facilities that submitted data to the PADEP.

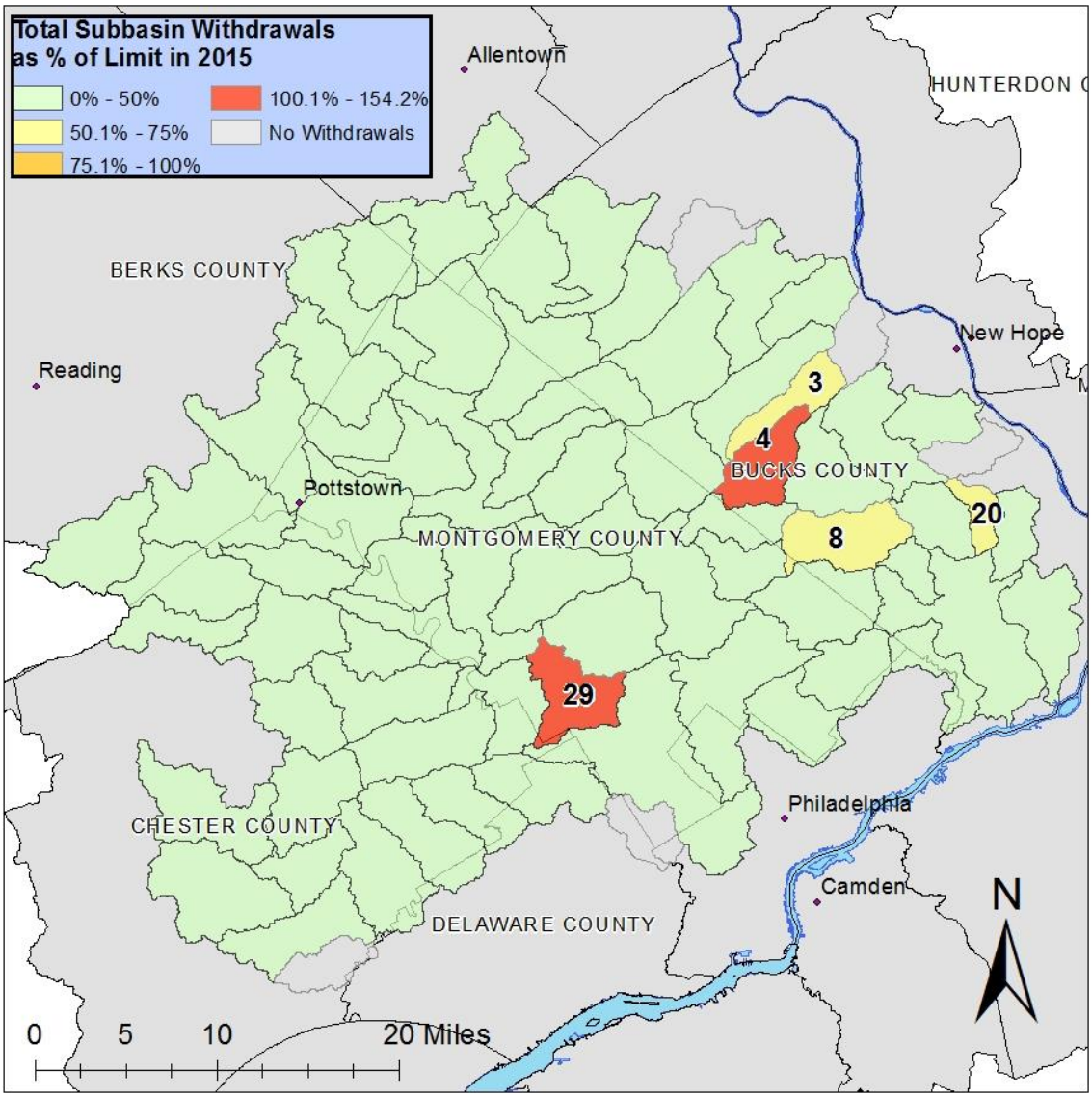



**Figure 20. Four (yellow) subbasins are currently between 50% and 75% of the withdrawal limit; one sub-basin (orange) is between 75% and 100% of its limit and considered potentially stressed; and one subbasin, where a major withdrawal from a quarry reservoir is counted as a groundwater withdrawal by PADEP, is above its withdrawal limit.**

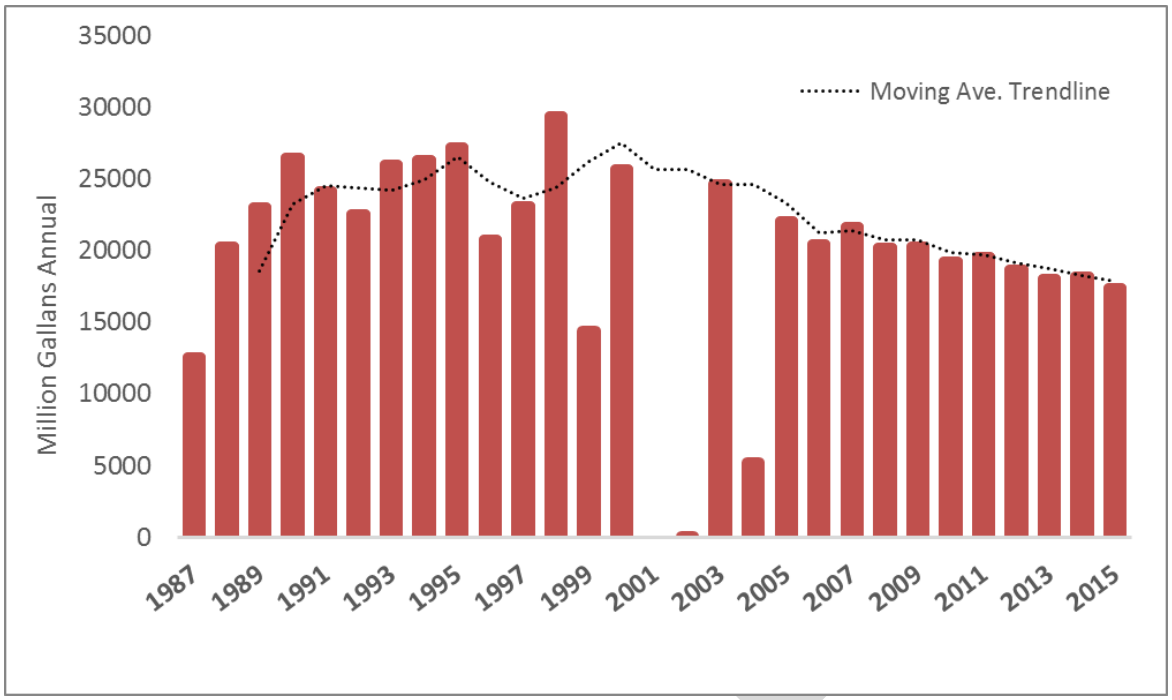



**Figure 21. Withdrawals in the PA Groundwater Protected Area from 1987-2015 generally show reductions over the past 15 years.**

**New Jersey Critical Area 2.** NJDEP and USGS regularly monitor groundwater levels in the affected aquifers of Critical Area 2 (CA2) in southern New Jersey, and assessments indicate that withdrawals have significantly decreased beginning with the program's inception in 1996 (Figure 22), resulting in concurrent rebounding of groundwater levels in most monitoring wells (Figure 23). The surface water diversion/treatment facility on the Delaware River in Delran, Burlington County, owned and operated by the New Jersey American Water Company, was chosen as the regional water supply alternative for Critical Area 2. The Tri-County Water Supply Project remains the primary water source to meet growing water demands in the region. The downward trend that is visible in Figure 22 is primarily the result of major infrastructure improvements to allow areas that were previously solely reliable on local PRM withdrawals to tap into the regional solution of the Delaware River Tri-County project which is primarily a surface water withdrawal. In addition, water conservation and indoor plumbing efficiencies as well as economic and business trends add to the overall downward trend in water withdrawals.

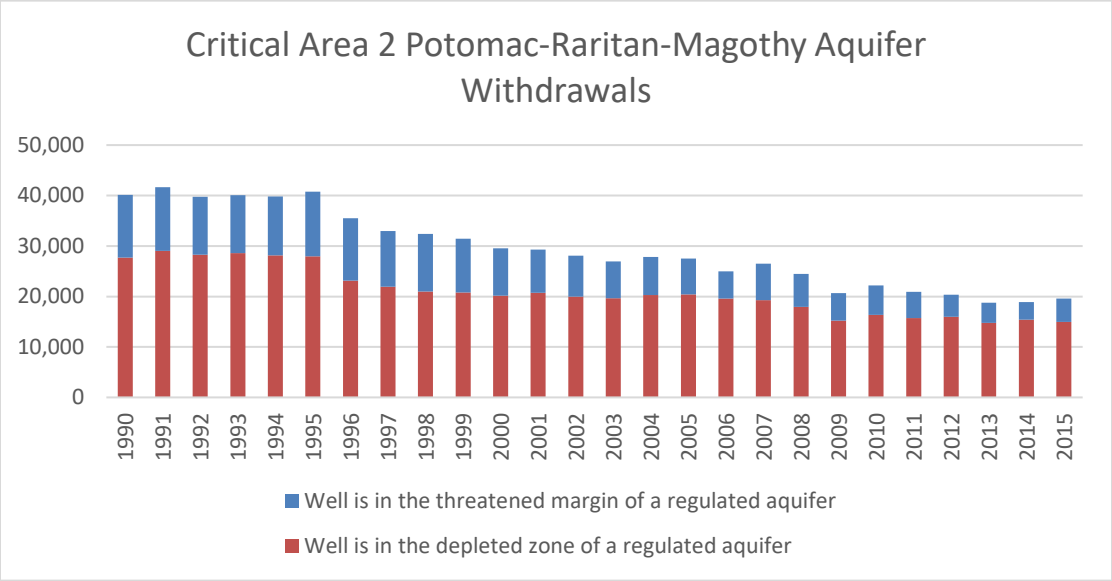



**Figure 22. Withdrawals from the PRM 1990-2015 show significant reductions since the inception of Critical Area 2 management in 1996. Source: S. Domber, NJDEP, Sept 2017.**

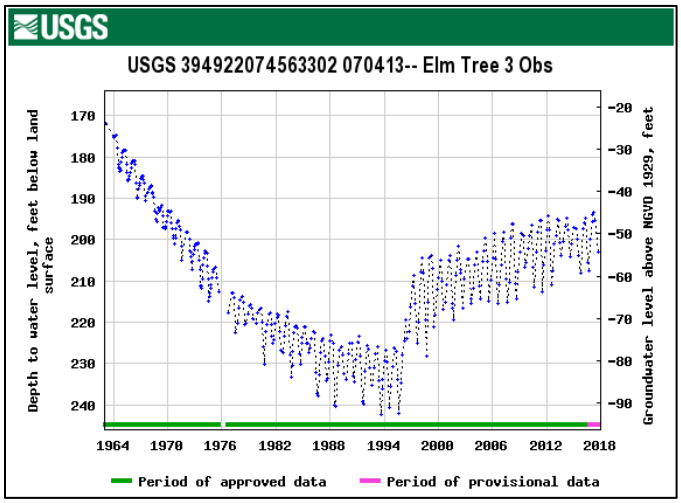



**Figure 23. Example of rebounding groundwater levels in the upper PRM of NJ Critical Area 2 since program inception in 1996. Elm Tree 3 observation well Burlington Co., NJ. Source: USGS, Sept. 2017.**

### Areas of Concern: PRM and Bayshore Watersheds

The 2007 report of a multi-year investigation by the USACE concluded that groundwater withdrawals in northern New Castle County, Delaware, were reducing local stream base flows and forming cones of depression. Pumping in Delaware is increasing groundwater flow from Maryland and decreasing flow into New Jersey by about 10% each[3], and regional pumping has created overlapping cones of depression across the study area of the three states.

**Delaware.** Critical water resource issues in the Rancocas, Piney Point, Cheswold, Federalsburg, Frederica, and Columbia aquifers of Kent County, DE have driven state capital funding of a multi-year program in Delaware to improve groundwater monitoring and the collection of detailed, baseline hydrologic information to inform near-term (e.g., 10 year) management options (see Figure 19). Monitoring have been installed in multiple aquifers at eight sites, and two USGS stream gaging stations have been re-activated. A focused effort is underway to improve monitoring infrastructure in the Columbia aquifer in the east Dover area where increased pumping for irrigation and the City of Dover are causing concerns for increased drawdown and saltwater intrusion. Salinity sensors will be installed near head of tide in several streams to provide information on the duration, intensity and frequency of saline water incursion. The project is making intensive use of automated instruments for collection of groundwater and surface water level, salinity, and temperature data. Plans also include collection of two rounds of groundwater quality sampling.



[3] USACE 2007 report on results of groundwater modeling of the Potomac aquifer:
*Updated Draft Groundwater Model Production Run Report, Upper New Castle County Delaware*.
Prepared for DE DNREC by USACE Philadelphia District; Feb. 2007.

The project, is a collaborative effort of the Delaware Geological Survey (DGS), USGS, Delaware Department of Natural Resources and Environmental Control (DNREC), and the Governor's Water Supply Coordinating Council (WSCC), will provide critical information on aquifer water quality conditions, yields, and pumping interactions to improve planning and provide management options for growing water demand in this region.

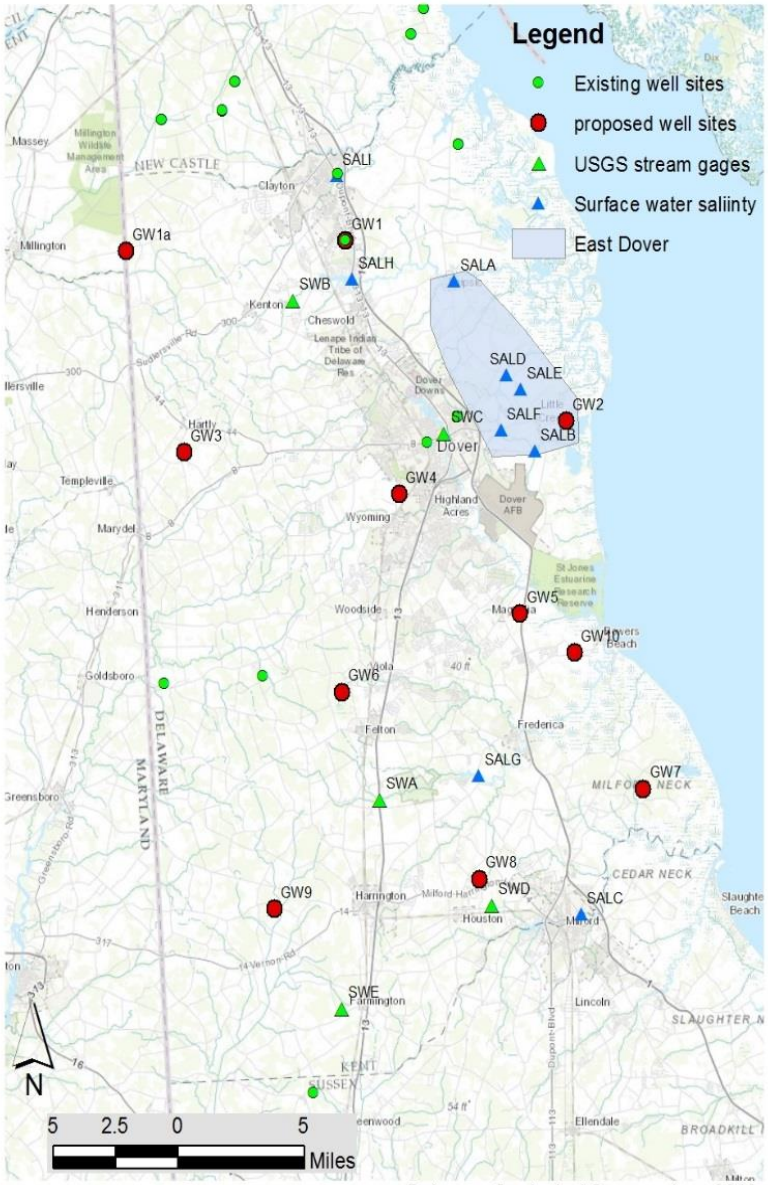



**Figure 24. Monitoring sites for Groundwater and Saline Water Intrusion Monitoring Network Infrastructure Improvements: Kent County, Delaware. Source: S. Andres DGS, Oct. 2017.**

Delaware has been an active participant in the creation of the National Groundwater Monitoring Network (NGWMN) and became a data provider to the NGWMN in 2015. The NGWMN is a consortium of state and local agencies and the USGS established to create a single point of access for scientists, engineers, policy makers, and the public to view and acquire important physical and chemical data on the nation's groundwater resources. The network allows users to view groundwater data across state lines to observe trends in groundwater quality and availability in a local, regional or national context. NGWMN resources are managed by the USGS Center for Integrated Data Analytics and can be accessed at http://cida.usgs.gov/ngwmn/.

**New Jersey beyond Critical Area 2.** NJDEP reports the development and release of the New Jersey Water Supply Plan 2017-2022, which is intended to improve the management and protection of the State's water supplies. The Plan is a critical document which emphasizes the need to balance traditional water use with water resource protection, while outlining a range of policy options to achieve that balance amid an array of competing interests and issues. The 2017-2022 NJSWSP differs from preceding plans as it is designed to allow for continuous technical and policy updates, as ongoing water resource evaluations, water use data, and more refined water demand projections become available. Using the NJWaTr Database, which is used to determine water budgets for the 151 HUC11 watersheds existing throughout NJ and to evaluate confined aquifer and surface water reservoir diversion rates, the State's future water supply planning efforts will be streamlined. In coordination with the extensive surface water, groundwater and drought monitoring systems and assessment tools, water supply planning at this scale represents

significant advancements from those provided in previous frameworks. NJDEP reports continued pursuit of its ability to maintain and allocate an increased Delaware and Raritan Canal diversion of 85 mgd during declared drought emergency, which plays a critical role in meeting New Jersey's current and future water supply needs, while enhancing water system resiliency in the Central, Coastal North and Northeast drought regions of New Jersey. NJDEP reports that saltwater intrusion is currently being observed in several observation wells throughout the Cohansey and Estuarine Sand Aquifers in Lower and Middle Townships in Cape May County. Increasing chloride concentrations in a public supply well within the Cohansey Aquifer located 2 miles to the east of the Delaware Bay have resulted in the shutdown of this production well and initiated the current investigation into the saltwater intrusion in the area. Recent water quality data suggest an existing plume of salty water migrating from the Delaware Bay side of the peninsula to the east and threatening public supply wells. NJGWS and local water purveyors have collected quarterly water-level elevations and water-quality data (sodium and chloride concentrations) in the established network of observations wells for the past 5 years. These data have been used by the Bureau of Water Allocation's efforts in effectively managing the Water Supplies of Cape May County.

**Bayshore Supply Alternatives.** A limited number of water supply alternatives are available for this area. Non-critical, confined aquifers are one option, but these may be limited depending on the magnitude of the diversion (e.g., Piney Point, Mt. Laurel-Wenonah) or by water quality problems (e.g., salt water in the Mt. Laurel-Wenonah). New Jersey American Water's tri-county pipeline, originally developed as an alternative source of water for the stressed municipalities in Critical Area 2, has now been extended through much of Gloucester County, including Logan, Harrison, East Greenwich, Woolwich, Pitman, and Elk Townships.

**National Groundwater Monitoring Network**

The National Ground-Water Monitoring Network (NGWMN) is a consortium of state and local agencies and the USGS that was established to create a single point of access for scientists, engineers, policy makers, and the public to view and acquire important physical and chemical data on the nation's groundwater resources. NJDEP has contributed data to the NGWMN since 2011 and DGS became a data provider for in early 2016. The network will ultimately allow users to view groundwater data across state lines to observe trends in groundwater quality and availability in a local, regional or national context. NGWMN resources are managed by the USGS Center for Integrated Data Analytics and can be accessed at http://cida.usgs.gov/ngwmn/.

### GENERAL STATEMENT OF BASIN SUPPLY SUFFICIENCY

Based on current and anticipated ground and surface water withdrawals, coupled with current operating restrictions (conservation releases, pass-by flows, consumptive use make-up, etc.) there is an adequate supply of water to meet both demand in the Basin and permitted exports from the Basin under normal conditions. Under medium risk conditions, e.g., 7-day average, one-in-ten-years (7Q10) low flow, demands can generally be met, except in a few sub-basins and select locations on the Schuylkill River. However, streamflow objectives and out-of-Basin diversions may not be able to be maintained during a recurrence of the 1960's drought (the drought of record in the Delaware River Basin), a rare occurrence.

Furthermore, groundwater in both NJ Critical Area 2 and the SEPA Groundwater Protected Area remains under close scrutiny, and conjunctive use of surface water is both recommended and, in some locations, necessary. More in-depth analysis and investigation is needed to provide a detailed forecast of supply adequacy during a repeat of the drought of record, under modified operating restrictions, or under different climatic conditions. The Commission proposes over the next three years to prepare a supply assessment under various scenarios and make recommendations for a Sustainable Water Future through 2060.

Recent studies by the US Army Corps of Engineers (USACE) have highlighted potential structural inadequacies in the Blue Marsh and Beltzville reservoirs, issues that will need to be addressed. The stored water is released to maintain minimum flows immediately below the reservoirs (conservation releases) and to support flow objectives (e.g., Delaware River at Trenton). DRBC is responsible for the annual debt service and a portion of operation and maintenance costs. These costs are reimbursed from the DRBC water supply charging program.

## C. SURFACE WATER QUALITY

### Surface Water Quality Assessment

Two major water quality assessments describe the water quality of the Delaware River Basin: The *Technical Report for the State of the Estuary / State of the Basin* a draft of which was completed in 2017, and the *2016 Delaware River and Bay Water Quality Assessment Report*. These two reports complement each other by utilizing different approaches to assess water quality. During the first quarter of 2018, DRBC will complete the 2018 Delaware River and Bay Water Quality Assessment Report.

**Table C1. Comparison of Water Quality Assessment Reports**

| Comparison | 2017 Water Quality Technical Report for the State of the Estuary / State of the Basin | 2016 Delaware River and Bay Water Quality Assessment |
|---|---|---|
| Evaluation Method | Use of Indicators | Compare observations to DRBC Criteria |
| Assessment | Current status, long term trends, future predictions | Supporting or not supporting designated uses |
| Term | 10-year data window for current status, full period of record for long term trends | 5-Year data window |
| Extent | Entire basin | Mainstem Delaware River only |

***Technical Report for the State of the Estuary / State of the Basin* - Chapter 3: Water Quality.**

This report, facilitated by the Partnership for the Delaware Estuary and written by DRBC, provided an assessment of water quality indicators for the entire basin, with special emphasis on the estuary. The technical report differed from, and complemented the 2016 Water Quality Assessment Report, in that it focused on metrics for which no criteria have been developed and evaluated long term trends. The Water Quality Technical Report--Chapter 3 of the Technical Report for the State of the Estuary and Basin (TREB) will be completed and posted soon.

### *2016 Delaware River and Bay Water Quality Assessment*

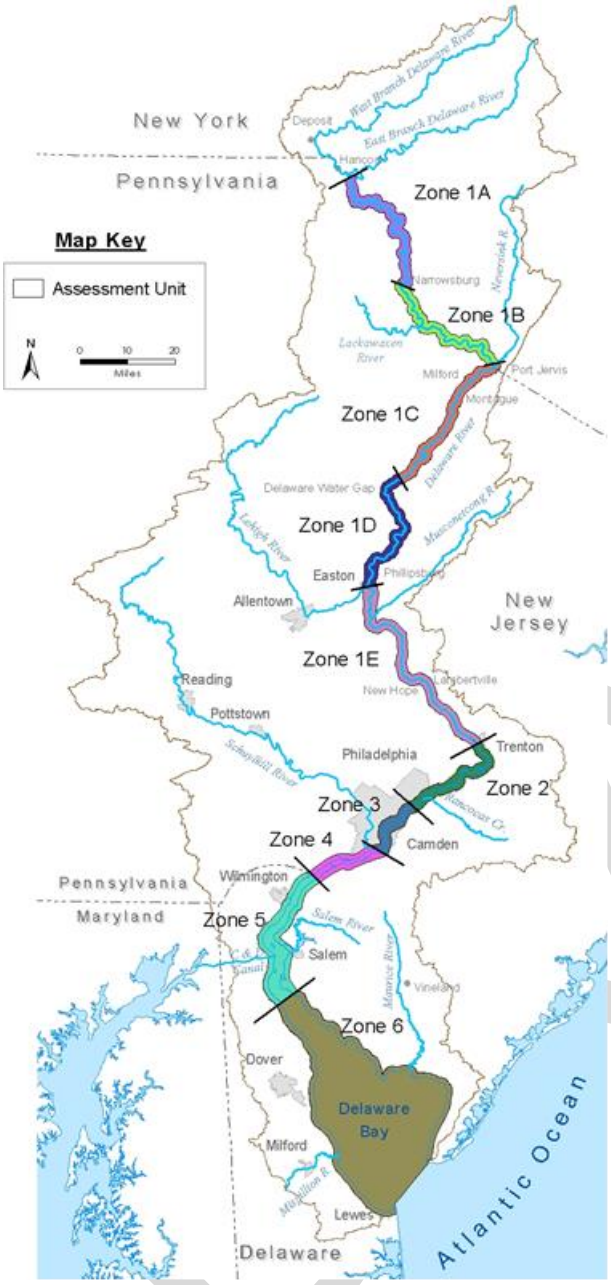



**Figure 25. Delaware River Basin Water Quality Zones**

The Water Quality Assessment (previously called the Integrated Assessment) performed by DRBC focuses on the mainstem Delaware River, comparing observations to water quality criteria to determine whether water quality is sufficient to support designated uses. Designated uses for the River include: Aquatic life, Public Water Supply, Recreation, Fish Consumption, and Shellfish Consumption, although not all uses are designated in all water quality zones (see Figure 25). Assessments to determine support of the designated uses of the Delaware River are reported in the 2016 Delaware River and Bay Water Quality Assessment at:

http://www.nj.gov/drbc/quality/reports/wq-assessment-rpts.html

### GENERAL STATEMENT OF BASIN WATER QUALITY

Overall, water quality in the Delaware River and Bay is good, with the majority of observations meeting criteria.

**Aquatic Life.** Support of the aquatic life designated use is assessed by evaluation of dissolved oxygen, pH, turbidity, temperature, TDS, alkalinity, toxic pollutants, and biology. The majority of observations met water quality standards. Additional detail on select portions of the assessment in support of Aquatic Life is provided below:

**Conventional Pollutants**

- **Dissolved Oxygen.** The vast majority of the measurements met criteria. All criteria were met in Zones 1A, 1E, 3, and 4. In Zones 1C and 1D, all instantaneous minima criteria were met. All seasonal mean criteria were met in Zones 2 through 5. The majority of observations met minimum or 24-hour mean criteria in all Zones.

- **pH.** Criteria were mostly met, with the exception of Zones 1A, 1B, and 1E, where daily pH maximum values routinely exceeded the maximum criterion of 8.5.

- **Turbidity.** The majority of observations met criteria for turbidity in all Zones.

- **Temperature**. As noted in previous assessments, temperature criteria in Zones 1A through 1E are clearly oriented toward determining compliance of thermal mixing zones for point discharges. In July 2016 DRBC presented options for development of new temperature criteria to its Water Quality Advisory Committee (WQAC) for discussion at meetings in 2017. In Zones 3 through 6, the majority of observations met criteria. In Zone 2, approximately 87% of observations met criteria. Atmospheric temperatures and meteorological conditions are strong drivers of water temperature.

- **Toxic Pollutants**

    - **Copper.** Data showed multiple exceedances in Zone 5 of the chronic freshwater criterion for copper using the DRBC regulatory hardness of 74 mg/L CaCO3 in the hardness based criteria equation but not more than one exceedance in three years when site specific hardness are used. Multiple exceedances of DRBC acute and chronic marine stream quality objectives were observed for copper in Zones 5 and 6. Assessment is complicated by factors such as field sampling and analytical issues with contamination, the applicability of DRBC's freshwater or marine criteria, a need to assess revisions to the current freshwater and marine criteria, and the influence of other water quality attributes that influence the partitioning and toxicity of copper.

      Exceedances of acute and chronic freshwater objectives for the support of aquatic life for dissolved copper were reported two times in Zone 1A and one time in Zone 1B, two acute exceedances and six chronic exceedances in Zone 1D computed with paired site specific hardness measured concurrently with the toxic analytical parameter and compared to numeric criteria values calculated with hardness measured at the nearest interstate control point (ICP) The apparent exceedances are low in both frequency and magnitude. For total copper measurements compared to total copper criteria (using conversion factors) one exceedance in Zone 1D and one in Zone 1E are observed.

    - **Aluminum.** Data showed multiple exceedances of aluminum acute and chronic freshwater objectives for the support of aquatic life in Zone 4. Exceedances of acute and chronic criteria freshwater objectives for the support of aquatic life in Zone 1 for aluminum.

- **Cadmium.** Exceedances of acute and chronic criteria for cadmium freshwater objectives for the support of aquatic life in Zone 1B if *J flagged* [4] data and samples with hardness < 25 mg/L are include in the assessment. No impairment with unflagged data.

**Public Water Supply.** Support of the Public Water Supply designated use is assessed by evaluating TDS, Hardness, Chlorides, Odor, Phenols, Sodium, Turbidity, Systemic Toxicants, Carcinogens, and Drinking Water Closures. The majority of observations met water quality standards for all parameters except certain carcinogens and systemic toxicants.

- Exceedances of human health objectives (carcinogens) for total PCB in Zones 1A, 1B, 1D and 1E. PCB were not monitored in Zone 1C.
- Exceedances were found in Zones 2 through 5 of human health objectives (carcinogens) for pesticides: DDD; DDE; DDT and Dieldrin in a 2012 low detection limit study using High Resolution GC/MS methods. Surface water was collected only once (a single day) which is insufficient to assess if stream quality objectives for the Delaware River were met. Exceedances were found in Zone 4 and 5 of human health objectives (carcinogens) for the pesticide heptachlor epoxide in a 2012 low detection limit study using a High-Resolution GC/MS method. Surface water was collected only once (a single day) which is insufficient to assess if stream quality objectives for the Delaware River were met.
- Exceedances of human health objectives (systemic) for mercury in Zone 1B.

**Recreation.** The DRBC water quality regulations sub-divide Zone 4 for bacteria criteria. The upper portion of Zone 4, above River Mile 81.8, is designated as secondary contact recreation only, while the lower portion of Zone 4, below River Mile 81.8, is designated for both primary and secondary contact recreation. Primary contact recreation is supported in all applicable Zones, except Zone 4 below RM 81.8, where there is insufficient data. Secondary contact recreation is supported in Zones 3 and 4.

**Fish Consumption.**
The fish consumption designated use applies to all DRBC WQM Zones. The assessment criterion is based primarily on the presence of the Basin states' fish consumption advisories in the mainstem Delaware River and Bay for the assessment period. The presence of fish consumption advisories results in an assessment of "not supporting the designated use." Advisories were issued for each assessment unit. There is no assessment unit without an advisory, so the use is not supported in any zone.

EPA approved a total maximum daily load (TMDL) for PCBs for Zones 2 through 5 in December 2003, and a second PCB TMDL for Zone 6 in December 2006. TMDLs are expected to be revised by USEPA in 2017 based on documentation prepared by DRBC staff.

**Shellfish Consumption.** Shellfish consumption, as a DRBC designated use, only applies to DRBC Zone 6. For the 2016 assessment, approved harvesting areas were considered to be supporting the use. Prohibited waters were considered to be not supporting the use. Assessment units classified as special restricted and seasonally restricted are considered to be supported, but with special conditions. In total for the 2016 assessment, 616 $mi^2$ are in full support (82.4% of zone 6), 35.4 $mi^2$ are supporting with special conditions (4.7%), and 96.1 $mi^2$ are not supporting the shellfish consumption use (12.9%).

**Antidegradation: DRBC Special Protection Waters**
In recent years, three major advancements have been achieved in the Special Protection Waters program:

- The Lower Delaware Measurable Change Assessment 2009-2011 (DRBC 2016) was completed. This was DRBC's first assessment of measurable change since site-specific existing water quality (EWQ) targets were established in DRBC rules. Methods for determination of measurable change were successfully applied, showing that water quality has not degraded and, in many cases, has

[4] *J Flagged* means the reported result is an estimate. The value is less than the minimum calibration level but greater than the estimated detection limit (EDL).

improved. Only chlorides and specific conductance exceeded water quality targets at almost all sites, but both are still far better than water quality standards. The cause for this increase is believed to be winter road salting. Notable water quality improvements were observed in the Delaware, Lehigh and Musconetcong Rivers, where nutrient concentrations declined. This publication is available online at http://www.nj.gov/drbc/library/documents/LowerDel_EWQrpt_2016/LDel_EWQrpt_2016_entire.pdf and as a story map at http://drbc.maps.arcgis.com/apps/MapSeries/index.html?appid=e63f5f1320794666a7def165ff9ae0e4

- Site-specific EWQ targets have been developed for all Upper, Middle and Lower Delaware sites. There are currently 85 Delaware River and tributary sites. EWQ is documented in the Existing Water Quality Atlas of the Delaware River Special Protection Waters (DRBC 2016). Data were compiled from the DRBC/NPS Special Protection Waters (SPW) monitoring results; three USGS water quality investigations (Hickman and Fisher 2008; Siemion and Murdoch 2010; and Senior in press); and state monitoring results from PADEP, NJDEP and NYSDEC. This publication is available online at http://www.nj.gov/drbc/programs/quality/spw_ewq-atlas.html.

- Water quality models have been developed, calibrated, and are utilized for watershed-wide cumulative evaluations of wastewater projects for four regions: the Lower Delaware; the Lehigh River watershed; the Brodhead Creek watershed; and the Neversink River watershed. These models are regularly updated and used for No Measurable Change (NMC) evaluations of new or expanding wastewater facilities in DRBC's permitting process.

## D. Population and Landscape

The following statistics are based on the 2010 US Census; the county population figures are for 2015, are not corrected for the basin boundary and should be considered provisional. The next full census will be undertaken in 2020.

- The population (Figure 26) of the basin increased by nearly one half million people, from 7.76 million in 2000 to nearly 8.26 million in 2010 (increase of 6.3%). Between 2010 and 2015, the counties within or straddling the basin added an additional 240,500.
- If compared with the fifty states, the basin would rank 11th in population behind New Jersey and ahead of Virginia based on 2010 census data.
- Continued population growth at 6.3% per decade will mean an increase of 35.7% to 11.2 million people by 2060.
- The greatest concentration of developed land (and population density) continues to be in the Lower Region of the basin - the greater Trenton-Philadelphia-Camden-Wilmington area.

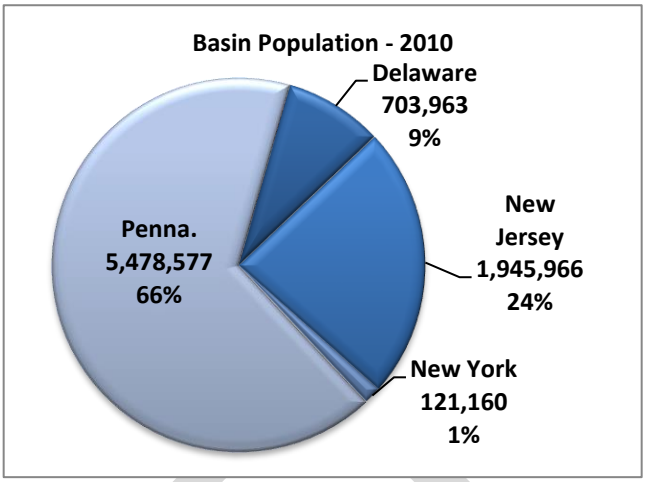



**Figure 26. Basin Population 2010. Pennsylvania accounts for approximately two-thirds of the basin's population. (Note: An additional 7 million people outside of the basin who rely on basin water supplies are not included in this figure).**

Between 2010 and 2015, the population in eight basin counties increased by 10,000 or more, including all three counties in Delaware and five counties in the Schuylkill watershed. Growth in the Delaware counties of Sussex and Kent are entirely dependent on groundwater, whereas the other growing counties have greater availability of water supply infrastructure and conjunctive use of source supplies.

| State | County | 2010 | 2015 | Change | % Change |
|---|---|---|---|---|---|
| PA | Philadelphia | 1,528,458 | 1,593,074 | 64,616 | 4.2% |
| DE | New Castle | 538,870 | 555,779 | 16,909 | 3.1% |
| PA | Montgomery | 801,134 | 817,719 | 16,585 | 2.1% |
| PA | Chester | 499,739 | 516,183 | 16,444 | 3.3% |
| DE | Sussex | 197,897 | 214,075 | 16,178 | 8.2% |
| PA | Berks | 411,791 | 425,383 | 13,592 | 3.3% |
| PA | Delaware | 559,373 | 572,676 | 13,303 | 2.4% |
| DE | Kent | 162949 | 174,025 | 11,076 | 6.8% |

Similarly, between 2010 and 2015, eight basin counties lost population: five in New Jersey, two in Pennsylvania and one in New York. Pike County PA, which in previous years was one of the fastest growing counties in the PA and the basin, is losing population. Also, unlike their counterparts across the bay in Delaware, the New Jersey Bayshore counties (Cape May and Salem) are losing population.

| State | County | 2010 | 2015 | Change | % Change |
|---|---|---|---|---|---|
| NJ | Cape May | 97,265 | 95,443 | -1,822 | -1.9% |
| NJ | Sussex | 149,265 | 147,557 | -1,708 | -1.1% |
| NJ | Salem | 66,083 | 64,928 | -1,155 | -1.7% |
| NJ | Hunterdon | 128,349 | 127,385 | -964 | -0.8% |
| PA | Pike | 57,311 | 56,544 | -767 | -1.3% |
| PA | Carbon | 65,204 | 64,470 | -734 | -1.1% |
| NJ | Warren | 108,692 | 108,332 | -360 | -0.3% |
| NY | Delaware | 47,980 | 47,623 | -357 | -0.7% |

Landscape change occurs very gradually across the basin, but is nonetheless worth tracking since landscape conditions can affect water resources. In the years between 1996 and 2010, the landscape has changed, although not dramatically in the aggregate. Net changes are summarized below and regional shifts in land cover are illustrated in Figure 27.

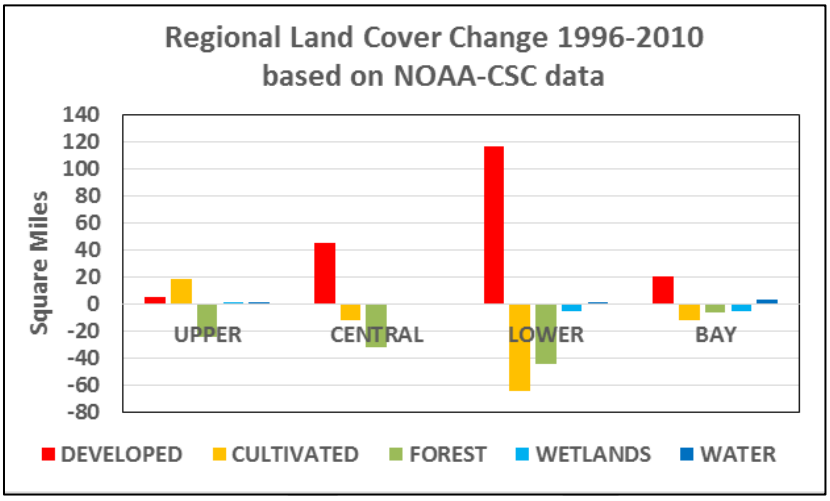



**Figure 27. Regional Net Change in Land Cover 1996-2010 illustrates the magnitude of change and the net gains/losses in land cover in the four basin regions. Forest loss was experienced across the basin. Based on analysis of satellite imagery from NOAA Coastal Services Center.**

- Developed land now covers nearly 2100 square miles, more than 16% of the basin
- Natural landscapes (e.g., forests, wetlands) cover slightly less than 60% of the landscape.
- Forested land, once a dominant feature, now accounts for less than half of the basin land cover and decreased by more than 100 square miles (approx. 68,460 acres) between 1996 and 2010. Continued loss of forest, crucial to sustaining water quality and availability, could have a negative impact on the long-term condition of the basin's water resources.
- Changes in wetlands appear to be less dramatic since no-net-loss policies have minimized losses from development activity. However, coastal wetlands face the threat of erosion and inundation from rising sea levels, effects exacerbated by their inability to migrate inland when trapped by existing developed land.
- Cultivated (agricultural and transitional scrub shrub landscapes) land experienced a net decrease during the period in all but the Upper region of the basin.

Changes in species composition can be expected with changes in climatic conditions including the transitioning of coastal freshwater wetlands to salt marsh, and the loss of once-dominant forest species—such as hemlock and oak—from infestation and disease supported by warmer temperatures. The overall effects of these changes on water resources remain to be examined.

Estimates of future population will drive both direct (potable supply) and indirect (energy-related, industrial) needs for water. Estimates of future land use/land cover and its implications for future water supply needs will be developed as part of the USGS National WaterSMART program and integrated into the Sustainable Water Future 2060 project.

## E. EMERGENT ISSUES

### Hydraulic Fracturing

Hydraulic fracturing in the Marcellus Shale and other formations in the Delaware River Basin could affect water resources. Work Program tasks related to hydraulic fracturing activity are found in the Special Section of II.

### Linear Infrastructure (Pipelines, Electric Transmission Lines)

The development of natural gas outside of the Delaware River Basin (Basin) has resulted in the modification and/or expansion of existing natural gas pipelines in the Basin and the construction of new natural gas transmission pipelines and supporting infrastructure (Compressor stations, etc.) in and through the Basin. The Commission has received, reviewed, and approved several applications in recent years, and additional transmission lines are proposed. Several transmission lines are proposed to convey the liquid by-products from the gas wells to refineries and markets in the Basin. In addition to the natural gas transmission lines, the Basin has experienced the reconstruction and or expansion of electric transmission lines. In part, the replacement of the existing infrastructure is due to its age, the need to improve delivery system reliability and redundancy, and to meet the growing demand of the Northeast United States. These projects traverse the basin and have the potential to impact water resource landscapes, including headwater watersheds and riparian corridors, as well as water quality.

### Other Energy Issues

Energy generation and transmission also introduce the potential for impacts to water resources. Among the projects that are under observation by DRBC are:

- The transition from once-through to evaporative cooling as existing or new power stations add capacity is expected to add to consumptive use of water.
- New natural gas power plants that are being proposed throughout to take advantage of cheaper, more regional sources of natural gas.
- Liquefied Natural Gas (LNG) proposals that would convert natural gas from regional or other locations into a liquid form for local use, and/or export to other areas of the country or overseas.

### Changing Climate

There is potential for changes to water resources in the Basin due to changes in climate and shifting regional weather patterns. While the science continues to evolve, several climate models predict that basin temperatures will increase, precipitation will stay the same or increase, and sea level will rise. Precipitation is predicted to occur in the form of fewer, more intense storms occurring in the winter months. This means a potential increase in flood events coupled with extended drought cycles. Increased temperatures will affect evapotranspiration rates and stream water quality. Turbidity levels will likely increase and dissolved oxygen levels decrease. Sea level rise may require increased releases from storage to augment river flows to repel salinity and/or costly modifications by water suppliers to treat increases in dissolved solids. Climate change could also affect instream flow and temperature conditions for aquatic biota. Work Program tasks related to water supply planning under future (2060) conditions, including potential climate change, are found in Section II.

### Perfluorinated Compounds

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a diverse group of compounds that have varying degrees of persistence, toxicity and bioaccumulation in the environment. They are found in a variety of industrial and household products such as stain repellant textiles, fire-fighting foams and paper coatings. They have unique properties to repel both water and oil. While there is still much to be learned about the effects of PFAS on human and ecological health, exposure from drinking water is a concern. In November 2016, EPA issued a revised health advisory for PFOA and PFOS, the most extensively produced and studied of the PFAS.[1] . Both substances have been detected in drinking water wells in basin states. PFOS has also been detected in fish tissue in the estuary. Available data for surface water show PFOA and PFOS levels are below current EPA and basin state human health advisory levels in segments of the Delaware

[1] See EPA Fact Sheet 800-F-16-003 https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf

River designated as drinking water sources. PFAS are contaminants of emerging concern that warrant further study. DRBC staff and the Toxics Advisory Committee (TAC) continue to review and assess PFAS in the Delaware River. For additional information, see Contaminants of Emerging Concern on the DRBC website at: http://www.nj.gov/drbc/quality/reports/cecs.html .

**Atlantic sturgeon** (*Acipenser oxyrinchus*)
Effective in April 2012, four geographically distinct populations of Atlantic sturgeon, including those of the New York Bight—which includes the Delaware River—were listed as endangered. Mature Atlantic sturgeon migrate from the sea to fresh water in advance of spawning, and juveniles remain in fresh water for several years Once abundant in the tidal Delaware River, spawning adults are believed to currently number fewer than 300. The Endangered Species Act requires species listed as endangered to receive the full protection under the Act to prevent extinction, including a prohibition against "take," which includes harassing, harming, pursuing, wounding, killing, trapping, capturing, or collecting. In August 2017, critical habitat for Atlantic sturgeon in the Delaware River was designated as the entire tidal river from the head of the tide at Trenton, NJ to the head of Delaware Bay. As part of the designated use studies, ichthyoplankton studies are planned in the tidal river to further examine the spawning and rearing habitat, and an assessment of the levels of protection provided by various dissolved oxygen concentration to life stages of the Atlantic sturgeon is also planned. These studies may have implications for certain stream quality objectives other than dissolved oxygen.

**Increasing Chloride Trends**
Over the past several years fresh water instream monitoring has shown an upward trend in chloride concentrations in the freshwater of the nontidal Delaware River, a trend apparently common to areas of the U.S. with significant roadway de-icing activity. While concentrations are still below criteria for drinking water and aquatic life use, the trend is of concern. Studies in NY, MD and VT indicated as early as 2005 that chloride concentrations in winter could increase as much as a hundred-fold over summertime levels in unimpacted forest streams, and that mean annual levels increase as a function of impervious surface—sometimes exceeding tolerance for freshwater life in suburban and urban streams.[5] Additional monitoring and investigation into sources, mitigation measures, and de-icing alternatives to salt and brine are needed.

**Micro Plastics**
Plastic is perhaps the most prevalent type of debris found in our oceans and large lakes. Plastic debris can come in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called "microplastics." Eventually, larger plastics degrade into smaller and smaller pieces; pieces smaller than 5mm in size are termed 'microplastics' and include originally manufactured products such as microbeads found in cosmetics and personal care products (such as toothpaste), industrial scrubbers used for abrasive blast cleaning, and resin pellets used in the plastic manufacturing process. 'Microfibers' are another type of microplastic that are generated from washing synthetic clothing made of polyester and nylon (petroleum-based materials). These tiny particles easily pass through water filtration systems and end up in receiving waters, posing a potential threat to aquatic life.

Microbeads are not a recent problem, but probably first appeared in personal care products about fifty years ago, with plastics increasingly replacing natural ingredients. As recently as 2012, this issue was still relatively unknown, with an abundance of products containing plastic microbeads on the market and not a lot of awareness on the part of consumers. On December 28, 2015, President Obama signed the *Microbead-Free Waters Act of 2015*, banning plastic microbeads in cosmetics and personal care products.

As an emerging field of study, not much is known about microplastics and their impacts yet. The NOAA Marine Debris Program is leading efforts within NOAA to research this topic. Standardized field methods for collecting sediment, sand, and surface-water microplastic samples have been developed and continue to undergo testing. Eventually, field and laboratory protocols will allow for global comparisons of the amount

[5] Kaushai, S.S., P. Groffman et al. "*Increased salinization of fresh water in the northeastern US,"* Proceedings of the National Academy of Sciences of the US (PNAS) Vol. 102 No. 38, Sept.20, 2005. http://www.pnas.org/content/102/38/13517.long Accessed 11/28/2017.

of microplastics released into the environment, which is the first step in determining the final distribution, impacts, and fate of this debris. USGS in partnership with National Park Service units in the Basin are conducting a 2018 research project that includes sampling in the Delaware River and Bay. The funded project is titled "*Occurrence and Potential Risk of Microplastics in Lake Mead & the Delaware River.*"

Funded by Delaware Sea Grant, researchers at the University of Delaware, are investigating the abundance and type of microplastics in water collected at 5 sites along Delaware Bay in Delaware and New Jersey. Preliminary results indicate a higher concentration of filament microplastics near industrial areas, higher concentrations of smaller microplastics (0.3mm-1mm) near Cherry Island landfill in Wilmington and Bombay Hook, although microplastics at Cherry Island were three times more likely to be larger (1-5mm) in size than smaller (0.3-1mm). Study results will inform project partners at the Delaware Department of Natural Resources and Environmental Control (DNREC) who are developing a strategy to investigate the extent and implications of microplastics in the Delaware Bay, as well as state water quality regulators concerned about the potential impact for fisheries, including oysters. The impacts on human health are not fully studied or known.

## II. WATER RESOURCE MANAGEMENT
**Summary of the activities and programs constituting the work plan for FY 2018-2020**

### A. GOALS AND PRIORITIES

The key water resource goals of the DRBC are:
- An adequate and sustainable supply of water for the Basin.
- Clean and heathy water resources throughout the Basin.
- Reduction of losses and impacts in areas prone to flooding within the Basin.

### COMMISSION FOCUS AREAS

1. Water Quantity
    - Perform modeling analyses for 2060 Sustainable Water Resources, including climate change considerations and pilot studies of Lehigh and Schuylkill watersheds. Begin pilot for the Brandywine watershed.
    - Support Decree Parties as they evolve the Upper Basin Flow Management.
    - Manage DRBC storage for salinity repulsion and monitor hydrologic conditions that may require Commission action.
    - Coordinate drought management actions with States, reservoir operators and facilities with consumptive use replacement requirements.
    - Develop Instream Flow Policy process in collaboration with state and federal agencies.
    - Collaborate with ongoing federal efforts and utilize resulting products, such as USGS Water Census and USACE CWMS model.
    - Develop updated water efficiency standards using USEPA WaterSense standards and/or Energy Star Certification.

2. Water Quality
    - Implement water quality program (monitoring, assessment, and modeling) supported by EPA Section 106 grant in the Special Protection Waters (SPW) and Delaware Estuary.
    - Collaborate with EPA and the basin states to implement PCB TMDL and complete establishment of Stage 2 TMDLs and revised implementation requirements.
    - Develop and calibrate estuary eutrophication model including collection of necessary data.
    - Conduct studies to determine the attainability of potential dissolved oxygen criteria in Zones 3, 4, and the upper portion of Zone 5 as outlined in Resolution 2017-4.
    - Convene a workgroup to identify early actions to reduce oxygen depleting discharges as described in Resolution 2017-4.
    - Complete coordination with advisory committees to recommend updates to DRBC water quality regulations for the main stem for key parameters, such as temperature and ammonia.

3. Regulatory Function
    - Review applications and issue dockets/permits for projects under DRBC lead.
    - Develop/update and implement the One Permit Program and associated administrative agreements (AAs) for collaborative permitting and technical coordination of state NPDES permits and water withdrawals.
    - Enforce conditions of dockets/permits through compliance program.

4. Collaborate with regional/state watershed partners: Partnership for the Delaware Estuary, Schuylkill Action Network, Christina Basin, Common Waters, Coalition for the Delaware River Watershed, National Park Service Wild and Scenic Rivers program, and state and federal committees/councils.

5. Agency Fiscal Management
    - Water Withdrawal and Discharge Project Fees: Continue to implement the annual monitoring and coordination fee program. Update the fee structure for review of project applications and coordination with state permitting programs.
    - Re-establish and/or maintain signatory party contributions.

## B. Water Resource Management Work Program

### Special Section: Hydraulic Fracturing

DRBC staff will support the development and advancement of hydraulic fracturing regulations and guidance consistent with leadership on this matter at the Commissioner level including the following activities as directed:

#### 1. Hydraulic Fracturing Regulations

Based on Commissioner level leadership, staff will continue to review and revise hydraulic fracturing regulations. Staff will provide support to the process leading up to an action on the regulations by the Commissioners.

#### 2. Comment and Response Document

As appropriate, based on Commission action, staff will prepare a Comment and Response Document that addresses public comments made on the draft hydraulic fracturing regulations.

#### 3. Guidance Materials

As appropriate, based on Commission action, staff will prepare guidance materials necessary for the implementation of hydraulic fracturing regulations.

#### 4. Program Implementation

Pending Commission action, staff will implement the program using the approved regulations and guidance materials.

## DRBC WATER RESOURCES PROGRAM



### 1.1 WATER SUPPLY STRATEGY: FORECASTING AND PLANNING

#### 1.1.1 Water Supply Planning for a Sustainable Water Future 2060

Building on the water use and demand evaluation work in past reporting efforts, the Commission will integrate efforts to prepare a detailed and comprehensive analysis of water demand, availability, and sufficiency through 2060. Past analyses, as well as recent condition reporting (see Conditions Section I of this Program) have identified areas where stress is evident and investigations are needed to identify additional areas of concern. Assessment of surface flows, aquifer conditions, anthropogenic supply needs, permitted allocations, and ecological needs will be compiled to identify long-term sustainability concerns and suggest appropriate action. Existing models along with innovative methodologies for integrating models will be employed for the assessment and to determine areas where additional storage may be needed.

The work plan includes:

- Water demand projections associated with thermoelectric power generation and other energy production and exploration.
- Analysis of the water audits and recommendations for future actions.
- Assessment of water use records across all sectors.
- Assessment of instream flow needs for key ecological communities within the DRB.
- Assessment of water availability during a repeat of the drought of the 1960's, the Basin's drought planning benchmark.
- Assessment of water availability with predicted future climate trends.
- Identification of additional information and tools necessary to forecast future condition (demand, supply, climate) scenarios.
- Ongoing assessment of special groundwater management areas within the Basin.
- Consideration of need for groundwater withdrawal limits in areas outside of protection areas (e.g., GWPA).
- Review of the adequacy of supply storage facilities to meet future water use and in-stream needs.

While most tasks are included in Section 1.1 of the work program, others (e.g., those related to flow modeling or agency coordination), are described in other sections of the document as appropriate.

The DRB was selected as one of three focus areas nationwide to be included in the USGS WaterSMART[6] (Sustain and Manage America's Resources for Tomorrow) program. Program products include:

- Acquisition, management, and integration of water-use and water-supply data
- Development of ecological-flow science including enhancement of the existing Decision Support System for parts of the Delaware River and development of a streamflow estimation tool for ungaged sites
- Development of a hydrologic watershed model (WATER) to evaluate water stressors such as growth of population centers, the effects of land-use change, water use and the effects of climate variability and climate change on water resources in the basin.

[6] The WaterSMART initiative, and its component project the Water Census, are elements of Section 9508: National Water Availability and Use Assessment Program included in the Omnibus Land Management Act of 2009 (PL 111-11; http://www.gpo.gov/fdsys/pkg/PLAW-111publ11/pdf/PLAW-111publ11.pdf).

The results of the USGS WaterSMART DRB focus area study will contribute significantly to the information needs of the DRBC's Sustainable Water Future planning.

### 1.1.2 Supporting and Coordinating with State Water Supply Planning and Allocation

DRBC works closely with the states through the DRBC Water Management Advisory Committee and by serving on committees organized by the states for water supply planning and management. Basin states continue to improve their data collection efforts, which are critical for well-informed planning and management.

As reflected in the updated administrative agreements between the Commission and the states of New Jersey (2015) and New York (2016), the Commission is cooperating with the state permitting/allocation programs for the groundwater and surface water withdrawals in those states. DRBC administers a special program for the Southeastern Pennsylvania Groundwater Protected Area (SEPA-GWPA, see Section 1.3.2) on behalf of the Commonwealth of Pennsylvania. New York's water supply law (see primarily ECL article 15 titles 15, 16 and 33) was amended on August 16, 2011 (Laws of New York, Chapter 401), with most of the statutory amendments effective as of February 15, 2012. The amendments expand the permit program to include withdrawals for purposes beyond public water supply, such as those for commercial, manufacturing, industrial, and other purposes, and limit the permit program to only include systems with capacity to withdraw 100,000 gallons per day or more. Previously, permits were required for any volume of withdrawals for public supply. The revised rule indicates that since the NYSDEC, as a voting member of the DRBC, is integrally involved with the DRBC's water withdrawal approval processes, that if a water withdrawal occurs in the jurisdiction of the DRBC and the water withdrawal is approved by DRBC, as applicable, then the water withdrawal is exempt from the permit requirements of the rule.

### 1.1.3 Surface Water Charging Program

DRBC administers an ongoing Surface Water Charging Program, for water withdrawals, which includes on-line registration, reporting and invoicing, and provides resources through a Water Supply Storage Fund (WSSF). The WSSF is used to fund the cost-share debt service and joint use operations and maintenance of Blue Marsh and Beltzville reservoir, facilities where DRBC holds water supply storage. This storage is used to ensure freshwater flows into the estuary during periods of low flow. The WSSF is also used to provide the local cost-sharing support for approximately a dozen USGS streamflow and water quality gages, used for flow management, water quality assessments, and flood forecasting by the NWS.

### 1.1.4 Facility Planning

The Commission has considerable powers of oversight relating to major facilities and projects affecting water resources in the basin, and… "for the determination of project priorities, pursuant to the requirements of the comprehensive plan and [the] water resources program."

The Commission will focus on several aspects of facility planning in the next three years:

- Review of basin-wide storage capacity and ability to meet projected water use and in-stream needs.
- Coordination with the USACE on the development of the Corps Water Management System (CWMS) model and several proposed potential studies, including a study to continue work on the Delaware Estuary Hydrodynamic Model for Water Resource Management for understanding Salinity and Eutrophication and a study re-evaluating the use of storage in F. E. Walter Reservoir for flood damage reduction, water supply, water quality and recreation

**1.1.4.A Beltzville and Blue Marsh Reservoirs.** The Commission owns water supply storage in two federal reservoirs—Beltzville (Lehigh River Watershed) and Blue Marsh (Schuylkill River Watershed)—and is responsible for their annual debt service and a portion of their operation and maintenance costs. The Commission will continue to use water in these reservoirs for water supply needs, including support of the Trenton Flow Objective.

**1.1.4.B Storage Capacity Adequacy and Options.** Review of the volume and adequacy of basin-wide storage capacity is part of the Water Supply Planning for a Sustainable Water Future Section 1.1.1.

**DRBC WATER RESOURCES PROGRAM**
**1.1. WATER SUPPLY STRATEGY**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Sustainable Water Future | Modeling analysis for Sustainable Water Supply 2060 Strategy | 2018 | General Fund |
| | Evaluation of basin-wide and regional water use, projections of future needs, supply alternatives | 2018-2020 | |
| | Modeling to determine areas where additional storage may be needed | 2018-2020 | |
| | Strategies for supply sufficiency through 2060 | 2018-2020 | |
| Support of State Programs | Coordination and support of basin state water supply programs | On-going | General Fund |
| Surface Water Charging Program | Program administration, on-line registration and reporting, invoicing | On-going | WSSF |
| Facility Planning | Review of basinwide storage capacity | 2018-2020 | General Fund |
| | Coordination with the USACE in studies related to reservoir uses and management | 2018-2020 | General Fund/ WSSF |

## 1.2 MULTI-OBJECTIVE FLOW MANAGEMENT

The main stem of the Delaware River is the longest un-dammed river east of the Mississippi, 152 miles of which are designated under the Wild and Scenic Rivers Act. However, dams on several large tributaries, which store water in reservoirs, regulate flow to the river through conservation releases. These facilities also provide flood mitigation, water supply, and instream flow augmentation. In addition to varying precipitation patterns, activities that affect instream flows include: releases, diversions and outflows from water supply and multipurpose reservoirs on tributaries, inter-basin water transfers from tributaries and the river, and water withdrawals from surface waters and interconnected groundwater sources. Low flows may impact ecosystems and reduce the assimilative capacity of the river for wastewater discharges. High flows may cause loss of life and property, but they are also a part of the natural hydrologic cycle. High flows and flooding events move sediment, provide inputs of coarse particulate organic matter that feed organisms at the base of the food chain, and periodically alter the river morphology and riparian corridor, which contribute to habitat and species diversity. Seasonal high flows also provide environmental cues that trigger spawning and lifecycle events for myriad species dependent on this river (e.g., American shad, oysters, mussels, Atlantic sturgeon).

### 1.2.1 Reservoir Operations

DRBC Staff are working with the National Weather Service (Philadelphia and Binghamton, Weather Forecast Offices; Mid-Atlantic River Forecast Center) to develop better flood warning products as well as useful forecast information of low flows for use in the determination of directed releases. DRBC will provide technical review of new procedures being developed by the Delaware River Master for the calculation of releases from the New York City reservoirs to meet the Montague Flow Objective and evaluate the accounting methodology for use of reserved water from the excess release quantity to meet the Trenton Flow Objective.

**1.2.1.A Upper Basin/Decree Party Flow Management.** Releases of water from the three New York City reservoirs (Pepacton, Cannonsville, and Neversink), located in the headwaters of the Delaware River Basin, out-of-Basin diversions, and main stem flow objectives are managed in accordance with procedures unanimously agreed to by parties to the 1954 Supreme Court Decree (New York State, Pennsylvania, New Jersey, Delaware, and the City of New York). The Agreement, known as the Flexible Flow Management Program, expired on May 31, 2017. In the absence of a long-term agreement among the parties, operations of the New York City Reservoirs reverted to D77-20CP and the out-of-basin diversions and flow objectives reverted to values specified in the Delaware River Basin Water Code, the default operating plan. Four of the Parties (DE, NYC, NY, and PA) consented to enhanced conservation releases from the NYC reservoirs, similar to those of the Flexible Flow Management Program (FFMP), until a new Agreement was implemented in October of 2017.

The new Agreement, a two-part, 10-year agreement signed by all the Parties, is similar to the FFMP, and known as FFMP 2017. The program and associated operating plan are intended to protect fisheries habitat downstream of the New York City Delaware Basin reservoirs, enhance flood mitigation, and repel the upstream movement of salt water in the Delaware Estuary without increasing the risks to the basin's water supplies. The agreement itself expresses the intent of the Parties to study various aspects of flow management over the first five year and make adaptive changes to the operating plan as information becomes available. Key issues to be studied include salinity repulsion, out-of-basin diversions and opportunities to increase storage.

Now that a longer agreement is in place, the Commission intends to codify various aspects of the FFMP through a public rule-making process. The Delaware River Basin Water Code will be evaluated and modified to reflect the operations of FFMP 2017. In the process, the Water Code will allow for adaptive modifications of the program without the need for a new rule-making.

**1.2.1.B Commission Storage (Blue Marsh and Beltzville).** During FY2016 Commission staff began reviews of the purpose, use and inclusion of Blue Marsh and Beltzville reservoirs in the Comprehensive Plan. In addition, other related Commission actions, such as dockets and resolutions, are being compiled and reviewed so that their intended use and the current status can be evaluated. The findings will be prepared for Commissioner review.

**1.2.1.C Docket Mandated Storage.** During FY2018 Commission staff will conduct reviews for projects where the Commission has required releases from storage to make up for consumptive use. The reviews will focus on the projects' relationship to the Comprehensive Plan. Other related Commission actions, such as dockets and resolutions, will be reviewed and compiled so that their intended use and the current status can be evaluated. The findings will be prepared for Commissioner review.

**1.2.1.D Consumptive Use Policy for Power Producers.** During FY2018 Commission staff will develop a consumptive use policy that will formalize the Commission's existing policy as it relates to the consumptive use make-up requirements of electrical generating or cogenerating facilities who consumptively use more than 100,000 gallons per day.

### 1.2.2 Ecological Flows

Several initiatives are underway to better identify the ecological flow needs of the Basin.

**1.2.2.A Non-tidal Mainstem and Tributaries.** In April 2012, the Commission and The Nature Conservancy (TNC) began a study to develop basin-wide ecosystem flow recommendations that can be implemented within the subwatersheds of the Delaware River (Management Step 1). The study was completed in December 2013. The study area focused on all tributary rivers and streams in the Appalachian Plateau, Ridge and Valley, New England, and Piedmont Physiographic Provinces, but did not include the streams of the Coastal Plain Physiographic Province. The project also summarized information about flow-sensitive species, communities, and ecological processes for the non-tidal mainstem Delaware River as far downstream as Trenton. The resultant recommendations will be an important component in a subsequent policy development process for in-stream flow requirements (Management Step 2). Such a policy could address pass-by requirements for water withdrawals, conservation release requirements for reservoirs, consumptive use mitigation triggers, and flow targets. The recommendations may also help the Commission and other Basin partners in the planning, design (location and size), and operation of future water supply storage facilities. In FY2017, the Commission categorized all the existing surface water withdrawals in the DRB. Policy development in FY2018-2020 will utilize these data relative to the stream setting they occur in, the type of water withdrawal, and the inventory of surface water withdrawals that currently have pass-by requirements.

A complementary project for instream flows is also part of the USGS's WaterSMART study for the Delaware River Basin. The United States Congress directed the USGS to produce a report describing the scope and magnitude of the efforts needed to provide periodic assessments of the status and trends in the availability and use of freshwater resources. As part of its Water SMART initiative (see reference in Section 1.1.1), USGS utilized ecological flow science in tributaries to develop a method to estimate daily mean flows for all ungaged streams in the DRB, aggregate biological data (i.e., fish and invertebrates) for the DRB, and define relationships between streamflow processes and aquatic ecosystem response. To support ecological flow science for the main-stem Delaware River, USGS proposed to update and enhance the existing Decision Support System (DSS) to accurately predict flow-habitat relationships downstream of the New York City's reservoirs. The DSS would be updated and enhanced to improve accuracy of predicted flow habitat relations and increase user friendliness and transparency of calculations. In addition, additional species of interest would be added and the DSS's modeled domain would be extended to include a larger portion of the Delaware System. The DSS will likely be used in consultations by the USFWS regarding the Dwarf Wedgemussel, an endangered species found in the upper basin. For more information see: https://cida.usgs.gov/nwc/#!data-discovery/projectDetail/5151f415e4b0f0b3d011a81a.

**1.2.2.B Estuary.** Freshwater inflow requirements for estuary populations, such as oysters and Atlantic sturgeon spawning, are a part of ongoing research by DRBC partners. For both instream and estuary flow needs, the seasonal components affecting both flow and temperature are currently the principal elements of concern. The Trenton flow objective was set to ensure adequate fresh water flows to protect drinking water intakes in the tidal river. Predictions indicate long-term diminution of snow pack and melt as a regional effect of climate change, which may have implications for flow management alternatives to meet the flow objective. The protection of instream flow needs may require adjustments to allocation and discharge permitting criteria, particularly if flow targets are adjusted.

### 1.2.3 Flow Modeling

An understanding of water supply, storage, and flow regimes is essential for managing the water resources of the basin. DRBC continues to develop and use modeling tools to aid in the evaluation of water resources management and associated risks in the basin. The models are used to assess reservoir operations for water supply, flood mitigation, power generation and recreation, the impacts of such operations on basin resources, the ability of reservoirs to meet intended and multiple objective uses, and the effectiveness of conservation releases. DRBC's Planning Support Tool (DRB-PST), a daily flow model used to assess flow management options is used to evaluate flow management options in the basin. DRBC has been working to update DRB-PST with improved code to simulate reservoir operations, add reservoir operations not previously modeled and include components of FFMP 2017 and options to simulate other programs, such as REV1. The revised model will be known as DRB-PSTv2 and released to the public in FY2018.

DRBC worked with the USACE Philadelphia District to compare salinity (chloride) predictions from the Commission's 1-D model (DYNHYD5/TOXI5) and the Corps' 3-D model (CH3Dz) and found that the models produced comparable results. The 1-D model is currently being linked DRB-PST. The linked models will be used to evaluate how flow objectives and reservoir operations impact salinity levels in the estuary. Salinity (specific conductivity) monitors have been added to three existing National Ocean Service (NOS) PORTS (Physical Oceanographic Real-Time System) Stations at Lewes, Cape May and Chesapeake City. Continuous salinity data from those three stations will be used to enhance the reliability of models for the Delaware Estuary.

See also Supplemental Table B for a summary of all proposed modeling activities.

**Hydrologic Reports.** A summary of hydrologic conditions in the basin including precipitation, streamflow, reservoir storage, groundwater levels, and the river mile location of the 7-day average 250 mg/l chloride concentration are prepared monthly, quarterly and annually. These reports are posted on the DRBC web site. In addition, flow and storage data are posted weekly on the website.

**DRBC WATER RESOURCES PROGRAM**
**1.2 MULTI-OBJECTIVE FLOW MANAGEMENT**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Upper Basin/ Decree Party Flow Management | Update drought management plan in Water Code | 2018-2020 | General Fund |
| | Analyses and Reports to support Decree Party decision-making | On-going | General Fund |
| DRB-PST | Improvements to DRB-PST (Planning Support Tool); New Release in 2018. | On-going | General Fund |
| Salinity Model | Work with the USACOE, Philadelphia District to complete comparison of salinity predictions from the Commission's 1-D model (DYNHYD5/TOXI5) and the Corps' 3-D model (CH3Dz). Update as new data become available. | 2018-2020 | General Fund |
| Hydrologic Reports, Event Summaries | Report – post on web | On-going | General Fund |

| | | | |
|---|---|---|---|
| Evaluate Reservoir Operations | Blue Marsh, Beltzville, Power sector and Brandywine evaluations | 2018-2019 | General Fund |
| Consumptive Use Replacement | Consumptive Use Policy for Power Producers | 2018-2019 | General Fund |
| Reservoir Operations | Direct releases for Trenton as needed | 2018-2020 | General Fund |
| | Work with the NWS to develop better low flow evaluation products for better directed release calculations | 2018-2020 | General Fund |
| Instream Flow Management Step 2 | Develop Pass-by flow, conservation release, consumptive use mitigation trigger policy (part of Sustainable Water Future 2060) | 2018-2020 | General Fund |

## 1.3 WATER SUPPLY MANAGEMENT: CONSERVATION, SPECIAL AREA MANAGEMENT AND PERMITTING

### 1.3.1 Water Conservation and Loss Accounting

DRBC's water conservation program incorporates a wide range of elements, including but not limited to requirements for metering, leak detection and repair programs, water conservation plans, water conservation performance standards for plumbing fixtures, and a water audit requirement to deliver staged improvements in accounting for water loss in distribution system based on the methodology proposed by the American Water Works Association (AWWA). The rule requires water suppliers to submit water audits annually. This information is used to inform water use analyses and improve water supply planning. Analysis of the results of this program are being used in the development of performance metrics. Additional areas of investigation may include compiling information on innovative water pricing structures, which could provide an incentive for water conservation, as well as stable revenues for water purveyors, and on water reuse to provide additional tools for improving water use efficiency.

### 1.3.2 Water Efficiency Standards

Staff is reviewing the potential implementation of updated water efficiency standards developed by USEPA WaterSense standards and Energy Star for inclusion in the DRBC Water Conservation Program. WaterSense is a voluntary partnership program sponsored by the USEPA, which provides a label for water-efficient products and a resource for helping you save water. According to USEPA, "the WaterSense label makes it simple to find water-efficient products, new homes, and programs that meet EPA's criteria for efficiency and performance. WaterSense-labeled products and services are certified to use at least 20 percent less water, save energy, and perform as well as or better than regular models. WaterSense partners with manufacturers, retailers and distributors, homebuilders, irrigation professionals, and utilities to bring WaterSense to your community. Our partnerships encourage innovation in manufacturing and support sustainable jobs for American workers." Over the next few years staff will review the potential water and cost savings from the WaterSense program as well as the basin-wide benefits of water use reduction to the public water sector.

### 1.3.3 Groundwater Management and Special Management Areas

**Southeast PA Groundwater Protected Area (SEPA GWPA)**

The Commission will focus efforts on the subbasins of the SEPA GWPA where use assessments indicate subbasins are potentially stressed or near their withdrawal limit. The Commission will continue to monitor conditions and work with docket holders and permittees to find realistic supply solutions and to ensure that

allocations support sustainability in the GWPA. The Commission also plans to enhance its tracking of groundwater level conditions and increase its use of annual hydrogeologic reports submitted by docket/permit holders. This information and program status report will be used to provide a more comprehensive analysis of groundwater levels across the GWPA.

### 1.3.4 Dockets and Permitting

DRBC's regulatory activities remain important for water supply management and planning. In order to eliminate unnecessary redundancy and to streamline project reviews, updated administrative agreements between the Commission and the states of New Jersey and Delaware were executed in December 2009 (NJ) and July 2010 (DE), with minor amendments made to both in May 2013. On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Permit Program (Rule). The Commission published a draft rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. The Resolution also authorized the Executive Director to enter into an administrative agreement with the NJDEP. In March 2015, an Administrative Agreement (AA) between DRBC and NJDEP was executed. Upon approval of the One Permit Program Rule, the One Permit Program portion of the AA was activated. In March 2016, an Administrative Agreement (AA) between DRBC and NYDEC was executed. DRBC will continue to support state partners in their permitting programs through data collection, assessment, and planning, and will issue water supply dockets in accordance with Administrative Agreements and special area management programs. The DRBC database will be updated to incorporate state permit conditions.

### 1.3.5 Compliance

Staff will continue annual reviews of DRBC-required data submission, such as the Water Audit Reports. Pre-emptive correspondence and notification systems will continue for docket expiration dates and data/report submittal date reminders.

**DRBC WATER RESOURCES PROGRAM**
**1.3 WATER SUPPLY MANAGEMENT**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Water Conservation and Loss Accounting | Assess data inputs from Water Audit submissions | Ongoing | General Fund |
| | Develop performance metrics for water loss accounting | 2018-2020 | |
| | Evaluate and develop updated water efficiency standards using USEPA WaterSense standards and/or Energy Star Certification | 2018-2020 | General Fund |
| Southeastern PA Groundwater Protected Area | Evaluate water use in subbasins of SEPA GWPA against allocation and supply limits | Ongoing | PA SEPA GWPA |
| | Prepare GWPA Status Report | 2018 | |
| Water Supply Dockets | Review and process water supply dockets in accordance with AAs | Ongoing | Project Review Fees |
| | Update DRBC database to incorporate state allocation permit conditions | Ongoing | General Fund |

| | | | |
|---|---|---|---|
| Compliance | Track construction start/completion forms, monitoring requirements, docket expirations | Ongoing | General Fund |

### 1.4 Determining Water Quality And Meeting Standards: Criteria-Based Programs, Anti-Degradation and Water Quality Administration

Note: Details on Aquatic Life, including ecosystem needs and restoration, are in Section 2.3.

#### 1.4.1 Special Protection Waters

The Delaware River Basin is unique in having many miles of high quality waterways in the midst of the densely populated Mid-Atlantic metropolitan area. They provide an enormous benefit to the citizens and workers of the Basin yet present a management challenge to maintain existing high water quality in a region that continues to grow. The Commission will continue to work with the states and federal agencies, including the National Park Service (NPS), in the implementation of the Special Protection Waters (SPW) program to maintain no measurable change to existing water quality (EWQ) in the non-tidal river. Implementation includes management through the DRBC dockets and state NPDES permits (including coordination of programs) and monitoring programs to obtain data to assess any changes to EWQ.

Commission staff recently completed a report evaluating monitoring data to assess measurable changes to EWQ in the Lower Delaware River, and also prepared an atlas of Existing Water Quality data for the Upper and Middle Delaware River and its tributaries. The EWQ targets are statistically-defined numeric targets for selected water quality constituents principally nutrients and conventional parameters. These site-specific water quality targets will improve the ability of DRBC and the states to implement Special Protection Waters permit review and assessment of measurable change.

Over the next three years, the following tasks are anticipated to capitalize upon the achievements described above:

- Periodic updates of the EWQ Atlas as new information become available.
- Proposed updates of water quality regulations as needed.
- Continued development and publication of SPW outreach and educational materials, including interactive maps, web applications to view and retrieve SPW data; and improved operating procedures for monitoring and assessment of the SPW region.

#### 1.4.2 Criteria Based Program

DRBC's criteria based program will continue to focus efforts on the assessment of water quality and support of project review.

#### 1.4.2.A Monitoring Programs to Assess Criteria

**1.4.2.A.1 Long Term Delaware Estuary Water Quality Monitoring.** The long term Delaware Estuary Water Quality monitoring program conducted by the Commission (formerly known as the Boat Run) was extended in 2017 to a year-round effort resulting in 12 sampling events at 22 stations. This program provides data to assess compliance with Commission water quality criteria and data on nutrient concentrations and potential effects. DRBC continues to employ rotational monitoring to ensure that all criteria are periodically assessed.

**1.4.2.A.2 Dissolved Oxygen Criteria Updates.** Although the worst of the dissolved oxygen problems have been addressed in the Delaware Estuary, dissolved oxygen conditions remain a concern. While current conditions typically meet the 1967 dissolved oxygen criteria, mid-summer dissolved oxygen is, at times, only 50% or less of full saturation levels in the areas around the Ben Franklin Bridge. At depressed oxygen levels, studies have shown that significant mortality can occur for juvenile fishes native to the Delaware Estuary (e.g., Atlantic sturgeon).

DRBC will continue working with co-regulators and the Water Quality Advisory Committee to define the highest attainable aquatic life use and supporting Dissolved Oxygen criteria in estuary Zones 3 to 5 as outlined in Resolution 2017-4, adopted on September 13, 2017.

**1.4.2.A.3 Nutrient Criteria Development.** The Delaware Estuary has both high loadings and high concentrations of nutrients relative to other estuaries in the United States. The effects from these high nutrients are not well-understood, but monitoring in the estuary shows signs of poor ecological health, including a persistent summer dissolved oxygen sag in the urban corridor of the estuary. The Delaware River Basin Commission serves as the lead agency for developing nutrient and/or nutrient-related criteria for the Delaware Estuary.

DRBC will develop a revised Nutrient Criteria Development Plan with submittal to EPA no later than November 30, 2017. DRBC will continue close coordination with State, Federal, and other stakeholders through its Water Quality Advisory Committee on issues related to establishing nutrient criteria.

DRBC is continuing its efforts to develop an Estuary Eutrophication Model using resources obtained through a grant under the Delaware Watershed Research Fund. Completion and calibration of this model will ultimately allow assessment of the attainability of wasteload allocations that will support the adoption of revised designated uses and associated dissolved oxygen criteria, and nutrient criteria, if needed.

**1.4.2.A.4 Polychlorinated Biphenyls (PCBs).** A polychlorinated biphenyl (PCB) is any of the 209 configurations of this organochloride molecule with 1 to 10 chlorine atoms attached to two phenyl rings. PCBs were widely used as dielectric and coolant fluids, for example in transformers, capacitors, and electric motors. Based on evidence that PCBs are persistent in the environment and can cause numerous health effects in the immune, reproductive, nervous, and endocrine systems of animals and humans, their manufacture and distribution were banned, but their use continues. Fish consumption advisories ranging from limited to no fish consumption, are issued by three states for Delaware Estuary because of elevated levels of PCBs in fish. Managing PCBs in the Basin is a major DRBC program. The Commission coordinates its activities to monitor and manage PCBs with the States of New Jersey, Delaware and Pennsylvania, and EPA Regions II and III, especially for incorporating PCB monitoring and Pollutant Minimization Plan (PMP) development and implementation in NPDES permits. Currently, approximately 94 dischargers are monitoring and/or implementing PMPs. Dischargers continue their submission of monitoring information to DRBC where it is housed in an Access database specifically developed for PCB data. This monitoring information is utilized in evaluating the temporal and spatial trends of PCB loadings and the effectiveness of Pollutant Minimization Plan (PMPs) in reducing PCBs. PCB loadings from traditional point source discharges achieved 64% reduction since 2005 based on 2013 effluent data.

The Commission will continue the implementation of the Stage 1 and Stage 2 PCB TMDLs, including:

- Ongoing point source data review and assessment
- Evaluation of Pollutant Minimization Plans (PMPs)
- Implementation of the Action Levels requirement of the Stage 2 TMDLs in NPDES permits
- Support to U.S. EPA Regions II and III as they establish Stage 2 TMDLs for Zones 2 – 6, and assistance to EPA/states in the implementation the TMDLs.

Ambient water samples were collected in the summer of 2015 at 22 stations in Zones 2-6 for analyses of PCBs, dioxin/furans, pesticides, and PFCs. Fish tissue samples were also collected at 8 locations in the estuary and non-tidal river in 2015. Sediments and fish samples from Delaware Bay were collected in 2016 for a similar suite of chemicals. Collected information in multi-media will be assessed and compared with previously collected data to identify trends and to assess the effect of PCB reductions already achieved.

**1.4.2.A.6 Metals.** DRBC will be studying areas of elevated concentrations of metals and evidence of criteria exceedances. In addition, the Commission will coordination with basin states, EPA, and stakeholders on criteria development, monitoring and assessment of metals focusing attention on bioavailability of the following:

- **Copper.** Copper (Cu) is a naturally occurring trace element found in surface waters and, while essential to virtually all plants and animals, it can be toxic to aquatic life even in low concentrations. DRBC continues to monitor the parameters needed for input to the Biotic Ligand Model (BLM) to assess water chemistry influence on copper toxicity.

- **Aluminum**. Natural sources of aluminum include weathering of rocks. It is the most common metal in earth's crust. Other sources include mining, industrial processes and wastewater treatment with alum. Aluminum is a non-essential metal that can inhibit respiration by binding to ion channels interfering with essential element uptake or by accumulating on gills. DRBC will monitor DOC, pH and hardness for use in Multiple Linear Regression (MLR) to assess water chemistry influence on aluminum toxicity.

**1.4.2.A.7 Chronic Toxicity.** Chronic toxicity is caused by repeated or long-term exposure to low doses of a toxic substance. In 2000, the Commission determined that the assimilative capacity of Zones 2-5 for chronic toxicity had been exceeded. Based on the chronic toxicity studies of ambient river water from the tidal Delaware River undertaken by the DRBC in 2000 and 2001, Zone 5 is currently listed as a Category 3 water for chronic toxicity (From EPA Guidance, Category 3 means insufficient or no data and information to determine if any designated use is attained). FY 2018 work will focus data collection in the main stem of the river and bay to provide additional data to help address ambient water toxicity issues as recommended by the Ambient Toxicity Subcommittee of the Toxics Advisory Committee (TAC). The specific objectives of these studies are to assess if toxicity is present in water samples as measured by laboratory controlled methods for short-term chronic toxicity.

**1.4.2.B Contaminants of Emerging Concern.** The DRBC continues to cooperate with basin states, EPA and academics on a prioritized list of pharmaceuticals and personal care products (PPCPs), as well as perfluoroalkyl and polyfluoroalkyl substances (PFASs) and polybrominated diphenyl ethers (PBDEs), for further evaluation of sources, fate, and effects in water column, sediments, and biota: (http://www.state.nj.us/drbc/library/documents/contaminants-of-emerging-concernAug2013rev.pdf).

**1.4.2.B.1 Dioxins and Furans.** Dioxins/furans, by-products of industrial processes, are commonly regarded as toxic and persistent organic pollutants (POPs). Dioxins/furans are contaminants of concern contributing to fish advisories in the Delaware Estuary. There are 75 different dioxins and 135 different furans. DRBC has adopted water quality criteria for the most toxic compound: 2,3,7,8-TCDD. Dioxin/furan concentrations in fish tissue are currently being addressed through fish consumption advisories and other environmental management approaches in the Delaware Estuary. DRBC is coordinating with states and other agencies through the Toxic Advisory Committee (TAC) to assess these contaminants through the use of Toxic Equivalency Factors, which relate the individual dioxins and furans to 2,3,7,8 – TCDD. This involves periodic monitoring for these contaminants in fish tissue and sediments.

### 1.4.3 Water Quality Modeling

In the non-tidal river, model development will also continue with the ongoing calibration and validation of QUAL2K models for the Lower Delaware, Lehigh River, Neversink River, Brodhead Creek and smaller tributaries throughout FY 2018 to 2020. All models will be continually refined, recalibrated, or validated as more effluent or ambient data are available. Utilization of updated models in no measurable change evaluations of new or expanding discharges will reduce uncertainties.

In the estuary, under the guidance of the model expert panel, a screening level, horizontally 2-D EFDC hydrodynamic model is being developed. This hydrodynamic model will be linked with WASP8 eutrophication model. WASP model was initially developed in 1970s and is one of the most widely used water quality models in the United States and throughout the world. WASP model is capable of handling multiple pollutant types including nutrients and eutrophication. The most recent version, WASP8 will be used as a tool to develop feasible scenarios of controlling nutrients loads into Delaware River Estuary and Bay to achieve higher dissolved oxygen concentrations to support higher designated use. In addition, a sophisticated 3-D hydrodynamic and eutrophication models based on findings from the 1-D modeling effort, will be developed to support the Commission's assessment of the designated use and associated water quality criteria for dissolved oxygen, and for other elements of the Commission's Nutrient Criteria Strategy. See Supplemental Table B for a summary of ongoing and proposed modeling activities.

Near field modeling efforts to support issuing DRBC dockets or NPDES permits for an acute mixing zone, heat dissipation area, and/or TDS mixing zone will continue in FY 2018 – 2020.

### 1.4.4 Water Quality Dockets and Permitting

DRBC's regulatory activities remain important for water quality management. In order to eliminate unnecessary redundancy and to streamline project reviews, updated administrative agreements between

the Commission and the states of New Jersey and Delaware were executed in December 2009 (NJ) and July 2010 (DE), with minor amendments made to both in May 2013. On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Permit Program (Rule). The Commission published a draft rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. Upon approval of the Rule, the One Permit Program portion of the AA was activated. In March 2016, an Administrative Agreement (AA) between DRBC and NYDEC was executed. DRBC will continue to support state partners in their permitting programs through data collection, assessment, mixing zone analyses, no measurable change evaluations, and other modeling and will issue water quality dockets in accordance with Administrative Agreements and special area management programs, with continued emphasis on cooperative efforts to implement DRBC standards in shared waters. The DRBC database will be updated to incorporate state permit conditions.

### 1.4.5 Water Quality Assessment Report

DRBC biennially reports on the conditions of main stem river water quality relative to criteria in accordance with EPA guidelines for 305 (b) reporting. Results of the 2016 report are described in Section 1.C. The next report is due in April 2018. A draft methodology for the 2018 report is available on the DRBC web site at http://www.nj.gov/drbc/library/documents/WQAssessmentReport2018_MethodologyDRAFTsept2017.pdf

### 1.4.6 Compliance

Staff will continue annual reviews of DRBC-required data submission, such as the annual effluent monitoring reports (AEMRs). Pre-emptive correspondence and notification systems will be continued for docket expiration dates and data/report submittal date reminders.

**DRBC WATER RESOURCES PROGRAM**
**1.4 DETERMINING WATER QUALITY AND MEETING STANDARDS: CRITERIA-BASED PROGRAMS, ANTI-DEGRADATION, WATER QUALITY ADMINISTRATION**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Water Quality Standards | Update water quality policy and standards for ammonia | 2018-2020 | General Fund |
| | Update designated uses for aquatic life in the estuary to reflect the highest attainable uses. | 2018-2022 | General Fund, Delaware Watershed Research Fund Grant |
| Scenic Rivers Monitoring Program | Continue maintenance monitoring as needed. | Ongoing | EPA §106, NPS |
| Lower Delaware River and Tributaries Model | Model refinement, calibration, and validation as needed. | Ongoing | General Fund |
| Brodhead Creek Model | Model refinement, calibration, and validation as needed. | Ongoing | General Fund |
| Neversink River Model | Model refinement, calibration, and validation as needed. | Ongoing | General Fund, |
| Lehigh River Model | Model refinement and validation as needed. | Ongoing | General Fund, |
| Boat Run Survey | Perform rotating monitoring plan to ensure periodic assessment of all parameters (criteria) | Ongoing | EPA §106 |

## DRBC Water Resources Program FY 2018 - 2020

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| | Data in WQX | Ongoing | EPA §106 |
| | Perform 305(b) Water Quality Assessment | Ongoing every even numbered year (Next 2018, 2020) | EPA §106 |
| | Perform technical assessments in support of State of the Estuary and Basin Reports | Ongoing every 5 years (Next 2018) | |
| Estuary Nutrients | Ambient monitoring for nutrient parameters | Ongoing | EPA §106 |
| | Initiate new round of point source nutrient monitoring in accordance with Resolution for the Minutes adopted September 13, 2017 | 2018-2020 | EPA §106 |
| Chronic Toxicity | Ambient surveys and trend analysis of effluent data | 2018-2020 | EPA §106 |
| PCBs | Evaluate PMPs and point source monitoring data | Ongoing | EPA §106 |
| | Support EPA in establishing Stage 2 TMDLs | 2018 | General Fund |
| | Continue implementation of Stage 2 TMDLs | 2018 - 2020 | General Fund, EPA §106 |
| Toxics (Ammonia, metals and emerging contaminants) | Coordination with TAC; recommended criteria revision | 2018-2020 | General Fund, EPA §106 |
| Water Quality Dockets | Changes to Water Quality regulation and Rules of Practice and Procedure, as required | 2018-2020 | General Fund |
| | Review and processing of water quality dockets per AAs | Ongoing | Project Review Fees |
| Water Quality Assessment Report | Prepare assessment for EPA and states | 2018 | EPA 106 Grant/General Fund |
| Compliance | Construction start/completion forms, monitoring requirements, annual effluent monitoring reports, docket expirations | Ongoing | General Fund |
| Eutrophication Model for Delaware Estuary | Development of screening level 1-D eutrophication model | 2018-2019 | EPA §106, Delaware Watershed Research Fund Grant, PA CZM, General Fund |
| | Selection and development of a state of the art 3-D hydrodynamic and eutrophication model. Data collection for model calibration. | 2018-2020 | |

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| | Model calibration and validation for CBOD reallocation, potentially NBOD and/or ammonia allocations, and other nutrient parameters. | 2019-2021 | |

**Section 2.0 WATERWAY CORRIDOR MANAGEMENT**



## 2.1 FLOOD WARNING AND LOSS REDUCTION

Flood loss reduction is a shared responsibility among federal, state, and local agencies and organizations in the Delaware River Basin. DRBC's activities involve coordination, education, planning and permitting. DRBC's Flood Advisory Committee (FAC) brings together government and non-governmental stakeholders across jurisdictional boundaries and facilitates coordination among agencies to improve the basin's flood warning system and mitigate flood losses. DRBC will assist with and, as appropriate, coordinate efforts to improve planning to reduce flood losses.

### 2.1.1 Flood Mitigation Task Force Recommendations

As the result of pervasive flooding in 2004-2006, DRBC commissioners convened a Delaware River Basin Interstate Flood Mitigation Task Force. This Task Force produced an Action Agenda consisting of consensus-based recommendations in six priority management areas—flood warning, floodplain mapping, floodplain regulation, stormwater management, structural and non-structural mitigation, and reservoir operations—all focused on a more proactive and systematic approach to flood mitigation within the Delaware River Basin. Many of the priority recommendations have been completed in collaboration with NOAA/NWS, USGS, USACE, the Nurture Nature Center (NNC), and the DRBC Flood Advisory Committee. As funding becomes available, DRBC will continue to identify opportunities for collaborative implementation of the Task Force recommendations and track progress. DRBC staff will work with the FAC to update the "Completed and Ongoing Flood Studies and Projects in the Delaware River Basin" spreadsheet (working draft last updated September 2015). In the 21st century, the approaches to flood mitigation have largely been the responsibility of federal, state and local entities, and have been focused on preparedness and local, smaller-scale type projects. In FY2018, DRBC will assess its role in flood mitigation and review the needs and purposes of the Flood Advisory Committee.

In August 2017, DRBC submitted a proposal under Section 7001 of WRRDA to the USACE for the development of a Comprehensive Flood Mitigation Study of the Delaware River Basin. The proposed study would further the work of basin stakeholders in the development and implementation of flood mitigation strategies and result in an Integrated Water Resource Management Program for the basin that addresses the multiple goals and objectives for the use of water and water resource infrastructure within the basin, including drought management, habitat protection and flood mitigation.

### 2.1.2 Flood Warning and Preparedness

DRBC serves on the Mid-Atlantic River Forecast Center Customer Advisory Board, working to improve NWS products related to flood forecasting and warnings in the DRB and nationwide. As a continuation of previous Education and Outreach Efforts, DRBC has created a flood resources portal which makes the information more accessible and focus on flood warning products, preparedness and DRB flood issues.

### 2.1.3 Flood Mitigation

DRBC will be actively engaged with the federal entities to monitor the development of robust scientific information to support flood mitigation for the Basin. Up-to-date and regionally relevant information on changes in expected precipitation patterns, climate, and land use patterns, for example, could have a significant impact on how to prepare for storm events and manage floodplains.

Beyond planning and preparedness, reservoir operating plans and structural changes present opportunities for flood mitigation. As funding allows, DRBC will evaluate potential reservoir management options that may provide additional protection from flood damage, specifically via the development of flood mitigation plans outlining potential operational adjustments for the larger reservoirs in the basin.

**DRBC WATER RESOURCES PROGRAM**
**2.1 FLOOD WARNING AND LOSS REDUCTION**

| Program/Projects | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Interstate Flood Mitigation Task Force Recommendations | Identification of opportunities for implementation and tracking implementation of recommendations | 2018-2020 | General Fund, Agency In-Kind |
| Flood Warning Products and Messages | Collaborate with MARFC and NWS for improvements and expansion of flood warning products for the DRB | 2018-2020 | General Fund |
| Flood plain dockets | Review and processing of flood plain dockets | Ongoing | Project Review Fees |

## 2.2 ENHANCED RECREATION

Commission staff takes part in several efforts to enhance recreational opportunities in the basin. DRBC is one of many stakeholders involved in the effort to designate the tidal Delaware River a National Recreation Area; other key partners include the Pennsylvania Environmental Council and the Partnership for the Delaware Estuary. DRBC is also a member of the Urban Waters Federal Partnership, which helps coordinate and focus federal resources on the urban waters of Philadelphia, Camden, Chester, and Wilmington, and includes numerous local and regional partners. DRBC staff also participates on the steering committee for the Delaware River Sojourn, which plans an annual paddling trip on the river focused on promoting river recreation and environmental stewardship.

DRBC will review plans for enhanced fisheries protection from Beltzville Reservoir when a proposal is developed by the Pennsylvania Fish and Boat Commission (PAFBC). There is a proposed potential USACE study that would re-evaluate F. E. Walter Dam's services including flood control, water supply, water quality and recreation and existing infrastructure and operations to support the current and future demand for services. DRBC will work with the USACE in scoping, coordinating and evaluating the impacts of the potential options.

## 2.3 AQUATIC LIFE AND WILDLIFE HABITAT IMPROVEMENT

### 2.3.1 Ecosystem Needs

DRBC intends to remain involved in the development and expansion of creative funding opportunities, such as the Delaware River Basin Conservation Act, which was authorized by Congress in 2016. DRBC will continue to increase the understanding of ecosystem needs and habitat conditions in the basin through ambient water quality monitoring, fluvial geomorphologic assessments, and macroinvertebrate and periphyton surveys conducted in partnership with federal and state agencies. Commission staff continues to monitor macroinvertebrates, algae and habitat of the non-tidal Delaware River, working to improve DRBC's existing macroinvertebrate Index of Biological Integrity (IBI) for assessing the aquatic life use of the Delaware River. See also Section 1.2.2. for Ecological Flows.

### 2.3.2 Ecosystem Restoration

PPL Martins Creek NRDA**:** The Commission has agreed to function as the recipient and distributor of certain funds required to be expended as a result of the damages resulting from the 2005 Ash Slurry Spill from the PPL Martins Creek facility, located in Lower Mount Bethel Township, Northampton County, Pennsylvania. The Natural Resource Damage Assessment (NRDA) was developed for the spill by PADEP in consultation with the NJDEP, PA Fish and Boat Commission, and DRBC. With the settlement agreement ratified in 2016, the Commission will manage the funds for restoration projects located entirely within Pennsylvania and those defined as "mussel restoration projects," which may be located in Pennsylvania and/or New Jersey. The Pennsylvania restoration projects consist of dam removals on the Bushkill Creek and the Little Lehigh River. The Commission is in the process of entering into grant agreements with local watershed organizations, which are expected to assume lead roles in removal of the identified dams located within

Pennsylvania. The watershed organizations will be responsible for all design, permitting, administrative and construction costs. DRBC staff will oversee performance under the Settlement agreement to ensure that the deliverables are carried out in a timely manner and are consistent with the Settlement terms.

### 2.3.3 Regional Sediment Management

The USACE and USEPA have led a group of agencies in the development of a Regional Sediment Management (RSM) Plan as recommended in the *Water Resources Plan for the Delaware River Basin 2004* (Basin Plan, Objective 2.3.F.) Two Teams have been created: the RSM Workgroup Implementation Team will work with agencies and other entities to oversee the beneficial re-use of dredged material; the Regional Dredging Team (RDT) will work to address water quality issues during the dredging process and at dredged material placement sites. DRBC staff will continue participation in both teams.

**DRBC WATER RESOURCES PROGRAM**
**2.3 AQUATIC LIFE AND WILDLIFE HABITAT IMPROVEMENT**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Ecosystem Needs | Review data and create an Index of Biological Integrity | 2018-2020 | General Fund |
| Ecosystem Restoration | Manage distribution of funds for PPL Martins Creek NRDA projects | 2018-2020 | PPL NRDA settlement via PADEP |
| Regional Sediment Management | Participation in RSM Implementation and Regional Dredging Teams | 2018-2020 | General Fund |

## 3.1 INTEGRATED RESOURCE MANAGEMENT AND WATERSHED PARTNERSHIPS

### 3.1.1 Watershed Management Partnerships

DRBC is involved in watershed management efforts that include watersheds overlapping two or more states as well as projects within a single basin state, typically as pilot programs for larger multi-jurisdictional management efforts or when those projects have an effect on the basin. Staff is involved with collaborative partnerships in these watersheds:

- **Christina Watershed.** DRBC is a founding member of the Christina Basin Clean Water Partnership, which was established in the 1990s to improve source water quality in the 300-sq. mi. interstate watershed. DRBC participates in activities and provides support as the Partnership continues implementation of its long term clean water strategy.

- **Schuylkill River Watershed.** DRBC is a founding member of the Schuylkill Action Network (SAN), a collaboration among federal, state, and regional agencies for local implementation of source water protection projects. DRBC serves on the Executive Steering and Planning Committees to oversee Work Groups that prepare and execute projects to improve the management of stormwater, agricultural activities, wastewater discharges, and mining reclamation. In addition, a portion of the Schuylkill River Restoration Fund (see below) is directed to projects identified through SAN as priority source water protection projects.

- **Common Waters.** DRBC is a member of the Common Waters collaborative, which is led by the Pinchot Institute and dedicated to protection of the headwaters of the Delaware River Basin, a drinking water source for millions of users.

- **Coalition for the DRB Watershed.** This is a coalition of non-governmental organizations created to achieve greater national recognition and funding for the basin. DRBC's involvement is limited to general assistance and participation in the annual Forum.

- **Delaware River Watershed Initiative.** This initiative has brought significant financial resources to bear in eight geographic areas (watershed "clusters") in the basin through the support of the William Penn Foundation. DRBC is involved in an advisory committee that provides oversight for mapping and modeling future growth (DRB Land Use Dynamics) led by Shippensburg University. Several SAN projects in two Schuylkill "clusters" are supported by WPF funds through this initiative. Projects are also supported in Brandywine-Christina Basin and Poconos-Kittatinny cluster located in the basin headwaters.

### 3.1.2 Watershed Restoration

The Schuylkill River Restoration Fund, a unique public/private partnership, provides grants to local governments and non-profit organizations for projects that improve the quality of water in the Schuylkill watershed. The grants focus on three major sources of pollution: stormwater run-off, agricultural pollution, and abandoned mine drainage. DRBC participates in the steering committee that reviews proposals, selects projects for funding, and oversees program direction and expansion. The Executive Director is responsible for approving the distribution of Exelon Generation LLC's contributions to the SRRF.

### 3.1.3 Delaware Valley Early Warning System

The Delaware Valley Early Warning System (EWS) is an integrated monitoring, communication, and notification system used to provide advanced warning of water quality events to water suppliers and industrial intake operators in the Schuylkill and Delaware River watersheds. The EWS was initially deployed in 2004 and by 2008 had grown to include over 250 users in 47 different organizations within the EWS coverage area. The Commission is one of many EWS partners, which include 23 water treatment plants (WTPs) from 12 utilities in Pennsylvania and 5 WTPs from 5 utilities in New Jersey, along with PA DEP, NJ DEP, US EPA, USGS, US Coast Guard, County Health Departments, and over 25 industries. The EWS

provides advanced warning of water quality events, web-based tools for determining proper event response, and a strong partnership between water users and emergency responders in the Schuylkill and Delaware River watersheds. The Commission currently serves as the "banker" for handling the annual administrative/user fees.

### 3.2 High Value Water Resource Landscapes

DRBC promotes sound practices of watershed management in the Basin (Compact §7.1). The Basin Plan goals regarding watershed management include:

- Preserving and restoring natural hydrologic cycles through improved stormwater management
- Maintaining and restoring the function of High Value Water Resource Landscapes
- The integration of water resource considerations into land use planning and growth management

The protection of water resources is indicative of all DRBC programs, regulations, and permit conditions.

DRBC participates in setting water research priorities and evaluating proposals submitted to the NJ Water Resources Research Institute (NJWRRI) for project funding through USGS.

**DRBC WATER RESOURCES PROGRAM**
**3.0 Linking Land and Water Resource Management**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Christina Clean Water Partnership | Continued participation to meet Long Term goal of restoring the water quality of all watershed streams to designated uses | Ongoing | General Fund |
| Delaware River Watershed Initiative | Participation in steering committees and workgroups as needed | Ongoing | General Fund |
| Coalition for the DRB | General assistance and participation in the annual Forum | Ongoing | General Fund |
| Schuylkill Action Network | Collaborative facilitation and oversight of watershed improvement projects for source water protection | Ongoing | General Fund |
| Common Waters | Collaborative led by the Pinchot Institute dedicated to protection of the headwaters of the Delaware River Basin | Ongoing | General Fund |
| Watershed Restoration: Schuylkill River Restoration Fund | Annual review and recommendations of projects for funding | Ongoing | General Fund |

## Section 4.0 INSTITUTIONAL COORDINATION and COOPERATION



### 4.1 INTERGOVERNMENTAL COORDINATION

**4.1.1 Federal and Interagency Collaborative Partnerships.**
It is important that the activities and authorities of the Commission and of the multiple federal, state, and local governmental agency efforts to manage the water resources of the basin are conducted in a coordinated and supportive fashion. Collaboration among state and interstate agencies across basin boundaries encourages the exchange of information, ideas, and experience and supports initiatives of benefit to member agencies and to water resources management generally. The Commission is involved in several federal/state initiatives that not only stimulate positive environmental outcomes in the basin, but also help shape water policy on regional and national scales. Other activities are focused on improving coordination and collaboration generally among federal and state agencies with authorities within the Basin, as well as with regional entities. This includes many ongoing as well as special initiatives.

- **Delaware Estuary Program.** Participation in multiple committees (Steering, Estuary Implementation, Science and Technical Advisory), as well as special projects (State of the Estuary) and events (biennial Science Conference). DRBC is assisting with the update of the Comprehensive Conservation Management Plan (CCMP) for the Delaware Estuary. DRBC is also assisting in the development of the next State of the Estuary/Basin report.
- **Upper Delaware Council.** DRBC is a non-voting member of the Council which encourages collaboration among municipalities in the Upper Delaware Scenic River corridor and reviews actions for conformity with the area-wide Management Plan.
- **Fish and Wildlife Management Cooperative -- Delaware River Basin**. DRBC participates as a non-voting liaison to this Cooperative, which deals primarily with fishery management issues. DRBC also assists the Cooperative with field work as well as giving guidance on Basin issues and initiatives.
- **Special Protection Waters (SPW) Monitoring Program.** This long-standing comprehensive water quality monitoring program (formerly referred to as Scenic Rivers Monitoring Program (SRMP)) is a collaborative partnership between the DRBC and National Park Service (NPS) on the Upper and Middle Delaware designations.
- **Lower Delaware Wild and Scenic Partnership River.** DRBC is a management committee member for implementation for the Lower Delaware Wild and Scenic Management Plan. DRBC has a collaborative relationship with NPS. DRBC conducts water quality monitoring and assessment in support of the Lower Delaware.
- **Delaware River Source Water Collaborative.** DRBC has been a partner in the Collaborative since 2010. DRBC will continue to work alongside USEPA and the basin states to further source water protection for the Basin.
- **Office of the Delaware River Master.** DRBC coordinates with the Office of the Delaware River Master on flow related issues and negotiations regarding the Decree Parties.
- **USFWS Delaware River Restoration Program.** The Delaware River Basin Conservation Act, signed into law in December 2016, emphasized the need for Federal, State, local governments and regional organizations to come together to identify, prioritize and implement restoration activities within the basin. The Act established the Delaware River Basin Restoration Program of which DRBC is a partner.

**4.1.2 State-DRBC Coordination**.
Actions and activities to improve coordination with agencies of the basin states include:

- **Update DRBC-State Administrative Agreements.** On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Permit Program (Rule). The Commission published a draft Rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. Since passing the Rule, DRBC has executed Administrative Agreements with New Jersey and New York.

- **State Advisory Committees.** DRBC participates in the New Jersey Water Supply Advisory Council, NJDEP Water Monitoring Council, and serves as a legislated member of the New Jersey Clean Water Council and the Delaware Water Supply Coordinating Council. DRBC also serves on the Drought Management Task Force for Pennsylvania.
- **New Jersey Water Resources Research Institute (NJWRRI).** DRBC is a member of the steering committee for the Institute in New Jersey at Rutgers University. Each state has a WRRI through which USGS provides funds to support research in water resource issues.

### 4.2 Data Sharing and Management

Maintaining a Geographic Information System (GIS), along with gathering, processing, and mapping new data, is crucial for water resource management programs and projects within and external to DRBC. Staff will continue to provide interactive maps on the DRBC web site to allow for continued public access to information and water resources data. Maintaining the Commission's Integrated Database, which includes water charging, water use, communications, and project review information, is also vital to implementing core Commission programs. Staff will continue efforts to assimilate data from the four basin states and maintain datasets to support analysis at the basin scale. The Commission's library and central files contain hard copies of the Commission's dockets and applicant information, vital to day-to-day operations and serves as the mechanism to capture and log official Commission actions.

### 4.3 Agency Funding

The Basin Plan acknowledges the necessity of securing adequate resources to support water resource management, as well as the challenge of doing so. DRBC management works to secure funding for ongoing agency support as well as for special projects. Staff efforts will focus on the following:

- Project/user Fees: Update and maintain fee structures for the regulatory program
- Re-establish and/or Maintain Signatory Party Contributions

### 4.4 Associations and Internal Advisory Committees

This category includes both voluntary partnerships with national and international organizations and committees assembled by DRBC for expert advice and support for the development and implementation of DRBC programs.

#### 4.4.1 Associations

DRBC remains a partner in the Association of Clean Water Administrators (ACWA), the Interstate Council of Water Policy (ICWP) and the American Water Resources Association (AWRA). As water resource management faces the growing challenges associated with a changing climate, a challenging fiscal future, infrastructure needs, and shifting political environments, involvement with these partners will be of increasing benefit to DRBC.

#### 4.4.2 DRBC Internal Advisory Committees

Continuing a long-standing practice, advisory committees aid the Commission in policy and standards development. Committees for flow, flood, toxics, monitoring, water quality, and water management meet on a regular basis. All administrative needs are met by DRBC staff, including the development of agendas, arrangement of venues, communicating with members, and processing formal meeting minutes. Staff also coordinates internally on issues that cut across the interests or expertise of more than one committee. Major focus issues for the Advisory Committees and subcommittees include:

- **Water Quality Advisory Committee.** The WQAC will be focusing on a review of nutrient issues in the estuary, the review of designated use and associated criteria for Zones 3-5, and the implementation of recommended revisions to ammonia and temperature criteria. Also, work is underway to: a.) develop a eutrophication model to test alternative water quality management scenarios and b.) facilitate outreach regarding management options. Work of an expert panel to consult on dissolved oxygen needs of estuarine aquatic communities will continue.
- **Regulated Flows Advisory Committee**. The RFAC serves as a vehicle for public input into the Flexible Flow Management Program and will continue to focus on reservoir operations, instream flow needs, and flooding.
- **Flood Advisory Committee.** The FAC will be focusing on outreach, coordination and collaboration for flood warning and mitigation, riverine and coastal flood mapping, and provide a forum for the continued interaction among local, state, and federal agencies and basin stakeholders.

- **Monitoring Advisory and Coordination Committee**. The MACC will review and offer recommendations for the improvement of basin monitoring activities and will seek to enhance coordination among the parties with respect to monitoring programs and data sharing.
- **Toxics Advisory Committee**. The TAC will be focusing on the review of new and existing toxics criteria including ammonia and emerging contaminants.
- **Water Management Advisory Committee**. The WMAC will continue to focus on the results of the water loss accounting program, evaluation of consumptive use policy, groundwater management and supply sufficiency. The committee will also review work on ecological flows as it progresses.

### 4.5 Utilizing Planning and Regulatory Authority

The Commission's planning and regulatory authority is used to facilitate, coordinate, and effect cooperation among water resource efforts across the Basin. Staff efforts to improve and direct the efficiency of DRBC programs include preparation of tools to guide resource allocation in accordance with Commissioner priorities. Based upon the mandate of the Compact and the goals of the Basin Plan, the Water Resources Program notes the current conditions and needs of the basin, the scope of DRBC programs, and the expected milestones to be achieved for a three fiscal year time horizon. The DRBC Budget details the receipt and distribution of financial resources in order to carry out the associated fiscal year activities.

- **Water Resources Program**. A prospective, multi-year program prepared annually.
- **DRBC Budget.** Prepared annually.

**DRBC WATER RESOURCES PROGRAM**
**4.0 Institutional Coordination and Cooperation**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Federal and Interagency Collaborative Partnerships | | | |
| USGS WaterSMART | Improved data and demand analysis; long-range water supply sufficiency analysis | 2018 | General Fund |
| Delaware Estuary Program | Participate in multiple committees (Steering, EIC, STAC) and in preparation of revised CCMP | Ongoing | General Fund |
| Upper Delaware Council | Ex-Officio Member; 4 meetings per year | Ongoing | General Fund |
| Fish and Wildlife Management Cooperative | Coordination, management plans | Ongoing | General Fund |
| Delaware River Source Water Collaborative | Participation in planning and education activities | Ongoing | General Fund |
| State – DRBC Coordination | | | |
| Revise/Update DRBC-State Administrative Agreements | Update and maintain DRBC-State Administrative Agreements | 2018-2020 | General Fund |
| Delaware Water Supply Coordinating Council | Meetings as scheduled, typically quarterly | Ongoing | General Fund |
| Pennsylvania Drought Task Force | Meetings scheduled as needed | On-going | General Fund |

| | | | |
|---|---|---|---|
| NJ Clean Water Council, permanent legislated member | Monthly meetings, periodic chairmanship, annual public hearing | Ongoing | General Fund |
| NJ Water Supply Advisory Council | Meetings as scheduled, typically monthly | Ongoing | General Fund |
| NJ Water Monitoring Coordinating Council | Meetings as scheduled | Ongoing | General Fund |
| NJ Water Resources Research Institute | Set research priorities; annual evaluation of research proposals for funding | Ongoing | General Fund |
| | | | |
| Data Sharing and Management | IT systems update and maintenance, GIS data assembly, processing and distribution | Ongoing | General Fund |
| Securing Funding | Meetings with federal and state legislators, state agency managers. Outreach to regulated community. | Ongoing | General Fund |
| Associations | | | |
| ACWA | Contribute to discourse on national water policy, federal legislation and support for gaging infrastructure, and the development of federal decision support tools for water resource decisions | Ongoing | General Fund |
| AWRA | | | |
| ICWP | | | |
| DRBC Advisory Committees | | | |
| DRBC Advisory Committees | Meetings as scheduled and/or necessary | Ongoing | General Fund |
| DRBC Strategic Documents | | | |
| Water Resources Program | Prepared annually | Ongoing | General Fund |
| DRBC Budget | Prepared annually | Ongoing | General Fund |

**Section 5.0 EDUCATION AND OUTREACH FOR STEWARDSHIP**



### 5.1 REPORTING

Many DRBC projects and programs have individual reporting elements. These are included as products and outputs for the fiscal year of their scheduled delivery. There are also routine reporting activities that require more significant resources for coordination, integration and production. Among these are:

- **State of the Basin Report.** By resolution, DRBC is to compile an indicators report every five years to review current trends and conditions in the Delaware River Basin. The next report is scheduled to begin in 2018.
- **DRBC Annual Report.** Required by the Compact, this report reviews programs, activities, products, and milestones achieved during a calendar year.

### 5.2 PUBLIC INFORMATION

DRBC staff responds in a timely manner to inquiries and requests from the public, federal/state/local government officials, regulated community, students, educators, and the news media. This includes hosting visits by international delegations who wish to learn from Commission staff about water resource management at the river basin scale. DRBC also produces various publications and materials about the basin and water resource management issues.

The DRBC's web site continues to be the primary communications tool with its emphasis on providing information that is accurate, up-to-date, and presented in a user-friendly manner. The DRBC web site makes extensive use of links to external government and other sites where additional information is available. Listserv capabilities allow DRBC to provide subject-specific information via email to recipients who have subscribed on the web site to receive updates. The DRBC uses several social media tools (Twitter, YouTube, and Flickr) to share news on Commission activities and related information. In addition, the web site is used for on-line project applications and reporting.

### 5.3 TECHNICAL OUTREACH

In order to keep current on technical issues and to share information with peers and various stakeholders, DRBC staff members attend and/or participate in regional, state, and national conferences and workshops throughout the year hosted by other government agencies, professional groups, or other organizations. DRBC periodically hosts workshops on timely issues. The DRBC web site is used to supplement this information exchange.

### 5.4 PROMOTING STEWARDSHIP

Commission staff communicates information in various formats and, as funding allows, participates in a variety of events, workshops, and conferences throughout the basin to raise public awareness about water resource issues affecting the watershed and the need for stewardship. DRBC continues to support the Delaware River Sojourn through its active membership on the steering committee.

**DRBC WATER RESOURCES PROGRAM**
**5.0 EDUCATION AND OUTREACH FOR STEWARDSHIP**

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Reporting | | | |
| State of the Basin Report | Indicators report – post on web | 2018-2019 | General Fund |
| DRBC Annual Report | Report – post on web; limited paper copies | Ongoing | General Fund |
| Public Information | | | |
| Provide Timely Information to the Public | Clear, consistent message on water resource issues and DRBC activities; produce various handouts | Ongoing | General Fund |
| Media/External Relations | Clear, consistent message on water resource issues and DRBC activities; timely responses | Ongoing | General Fund |
| Web Site | New features, improvements, updated information | Ongoing | General Fund |
| Host Foreign Delegation Visits | Information exchange | Ongoing | General Fund |
| Technical Outreach | | | |
| Conference Attendance and Presentations | Information exchange | Ongoing | General Fund |
| Social Media | Information exchange | Ongoing | General Fund |
| Stewardship Events | | | |
| Community Events | Delaware River Sojourn, Lambertville Shad Festival, EarthFest, HydroMania, Coast Days, educator training, etc. | Ongoing | General Fund |
| Event Follow-up | Information on web site | Ongoing | General Fund |

**SUPPLEMENTAL TABLE A: SUMMARY OF PROSPECTIVE CHANGES TO DRBC PROGRAMS AND REGULATIONS**

| Management Topic | Program/Project | Products/Outputs | FY 2018 | FY 2019 | FY 2020 |
|---|---|---|---|---|---|
| Hydraulic Fracturing | Planning and Project Review | Hydraulic Fracturing regulations and guidance | Evaluation, Rulemaking and Guidance Development as directed | | |
| Water Supply | Planning and Update to CP | Update Comprehensive Plan | Water Inventory, Water Budget and Needs Assessments | Water Supply Options | Initiate Comprehensive Plan Update |
| | | Update Existing Facilities Inventory | | | |
| Flow Management | Upper Basin/ Decree Party Flow Management | Update drought management plan in Water Code | Integrate 10-year agreement with Water Code | Rule-development and proposal | Update Water Code |
| | Ecological Flow Requirements | Update Water Code to include pass-by flows, conservation releases, and consumptive use mitigation trigger policies | Technical Review and Analysis | Policy Options and Recommendations | Rule-development and proposal, as appropriate |
| Water Quality | WQ Criteria | Stage 2 PCB TMDLs | Stage II Report; EPA to Establish TMDLs | | |
| | | DO (Zones 2-5) (WQAC Support) | Model Development | Model Calibration and Evaluation; Designated Use and DO Criteria Recommendations in 2021 | |
| | | Nutrients (Zones 2-6) (WQAC Support) | Model Calibration and Evaluation | Model Development | Recommendations for nutrient end points |
| | | Revised ammonia criteria (TAC Support) | TAC Recommendations | Rulemaking Process and Adoption | |
| | | Revised bacteria criteria (WQAC Support) | Review recommendations for nationwide standards by EPA, and coordinate with states. | Rulemaking Process and Adoption | |

| Management Topic | Program/Project | Products/Outputs | FY 2018 | FY 2019 | FY 2020 |
|---|---|---|---|---|---|
| Interagency Project Review Coordination | Project Review Permit Streamlining | Alignment with partner agencies to One Permit Program, where appropriate. | Implement Administrative Agreements (AA). | | |
| | Regulations and Rules of Practice and Procedure | Update Articles 3 and 4 of Water Code and RPP for clarity and consistency with AAs. | Updating of Water Quality Regulations, Water Code, and RPP. | | |
| | Project Review Fees | Update project review fee schedule | Rule adoption | Rule Implementation | |

* Note: order of prospective changes follows the format in the Water Resources Program – Section II

## SUPPLEMENTAL TABLE B: SUMMARY OF MODELING PROJECTS

| Program/Project | Products/Outputs | Fiscal Year | Funding Sources |
|---|---|---|---|
| Flow Management | Use of and incorporation of various upgrades into DRB-PST model to support the evaluation of water supply management options, salinity intrusion, and support Decree Party negotiations | On-going | General Fund |
| Water Supply Planning | Identify water availability tool and assess against Drought of Record | On-going | General Fund |
| | Use of USGS-WATER with PST for macro-scale sustainability analyses | On-going | General Fund, WSSF |
| Emergency Response | Real time one-dimensional flow and transport model | Daily | General Fund |
| | Water quality model | As needed | |
| Lower Delaware River and Tributaries Model | Model refinement and validation | As needed | EPA §106, General Fund |
| Brodhead Model | Model refinement and validation | As needed | General Fund |
| Neversink Model | Model refinement and validation | As needed | General Fund, EPA §106 |
| Lehigh River Model | Model refinement and validation | As needed | General Fund |
| Eutrophication Model for Delaware Estuary | Development of screening level 1-D eutrophication model | 2018-2019 | EPA §106, Delaware Watershed Research Fund |
| | Selection and development of a state of the art 3-D hydrodynamic and eutrophication model. Data collection for model calibration | 2018-2020 | EPA §106, Delaware Watershed Research Fund |
| | Model calibration and validation for CBOD, NBOD and ammonia allocations, and other nutrient requirements | 2020-2021 | EPA §106, General Fund |
| CORMIX mixing zone models | Project Review and NPDES permit support | As needed | Project Review Fees |